THURSDAY, JANUARY 25, 1894.

RECENT PUBLIC HEALTH WORKS.

A Treatise on Hygiene and Public Health. By T. Stephenson, M.D., F.R.C.P., and Shirley F. Murphy. Vol. ii. (London: J. and A. Churchill, 1893.)

Public Health and Demography. By Edward F. Willoughby, M.D., D.P.H. (Macmillan and Co., 1893.)

Methods of Practical Hygiene. By Prof. K. B. Lehmann. Translated by W. Crookes, F.R.S. In two vols. (London: Kegan Paul, Trench, Trübner, and Co., Limited, 1893.)

IN our review of vol. i. of the "Treatise on Hygiene and Public Health," it was pointed out that the various articles comprising it were written by men whose knowledge and experience upon the subjects allotted to them for treatment was a sufficient guarantee of good work, and that any faults that the reviewer might possibly detect in the volume must almost of necessity be those of omission. To this second volume—which contains matter of the greatest possible interest and importance to the student and practitioner of preventive medicine—the same remarks apply. It is at least equal in all-round excellence to vol. i.; but here and there a few points might, in our opinion, have been more fully dealt with than they are, especially in a book which is destined to become essentially the work of reference for those interested in public health matters.

Article I treats of "The Pathology of Infectious Disease," and is written by Dr. Klein. This is an excellent *résumé* of what is undoubtedly the most important branch of preventive medicine, and it forms one of the best features of the book. No one can question the authoritative value of an article coming from such a source; and the fact that it is well written, and the various stages of the study are carefully arranged and treated of in admirable sequence, make this difficult subject both easy and pleasant reading. Appended to the article is a wealth of illustrations, comprising plates of a large number of cover-glass specimens of cultures of the different bacilli, all beautifully clear, and many coloured to show the characteristic staining of bacilli and fungi in tissues and fluids; sections through pathological tissues, &c.; specimens of blood, mucus flakes and pus, showing bacilli; representations of a large number of tube cultures—streak, stab, shake, and surface; cultures on potato, and plate cultures. We fancy that a few illustrations of the apparatus employed in bacteriological research would be acceptable, and we note that no mention is made of Haffkine's work in anti-choleraic vaccination; this might certainly have been included, notwithstanding the circumstance that a valuable piece of destructive criticism, emanating from Dr. Klein, has thrown considerable doubt upon the value of the method.

The article which very appropriately follows upon the first is contributed by Dr. T. W. Thompson, upon the subject of "The Natural History of Infectious Diseases"; it is a careful and well-written article, leaving but little to be desired. The subject of the communicability of phthisis is, however, worthy of a little more space than that allotted to it, more especially as during the past two years a conviction has established itself among health officers that there is at present an enormous amount of preventible mortality from that disease, by reason of the fact that the malady is frequently traceable to infection from a pre-existing case; and there is every prospect, in the near future, of phthisis being brought more directly under the control of preventive measures.

Article 3, by Dr. J. C. McVail, gives an excellent summary of the work that has resulted in our present system of vaccination, and deals fully enough with the subject of anti-vaccination. The article contains many useful diagrammatic expressions of the deaths from small-pox, and the general incidence, age and sex incidence, types, &c. of the disease among both the vaccinated and the unvaccinated.

The subject of vital statistics has been entrusted to Dr. Ransome for treatment. It is, of course, a good article, but rather short, and hardly explanatory enough in some respects for the purpose of those who will doubtless consult the volume upon points which they have either not been able to understand or to gather from the perusal of the smaller works upon public health.

The main scope of Article 5 is the hygiene of those who live at sea, in ships as their houses, and with the sea and air as their environments. It is appropriate, therefore, that under the heading of "Marine Hygiene" the writer should treat of sea-water in its chemical and physical aspects; the various kinds of ships, and the material used in their construction; shipping and passenger statistics; the cubic space, ventilation, and temperature of cabins and bunks; the water supply of ships; and the sailor, his food and its preservation, his clothing, and the diseases to which he is especially subject. The best feature, and the most useful, of this admirable article is that bearing upon port sanitation, and Dr. H. E. Armstrong is to be congratulated upon a careful and valuable contribution.

The sixth article, upon military hygiene, is by Prof. J. L. Notter. It is substantially that which appears in the same writer's edition of Edmund Parke's work upon practical hygiene. It is well written and sufficiently exhaustive.

The article which deals with disposal of the dead consists of two parts. Part i. is contributed by Sir T. Spencer Wells, and treats of the various methods employed by different sects and nationalities. It is admirably written, extremely interesting, and is a powerful vindication of cremation. The second part is written by Mr. Frederick Walter Lowndes, who, while he discusses the question in a spirit of impartiality, maintains that there need be no difficulties and dangers in the prevailing method of disposing of the dead, if proper care be exercised in the selection of the site of the burial-ground and its subsequent management.

The volume is concluded by an excellent article upon the medical officer of health, by Dr. Ashby; and we are glad to find the writer advocating whole time service, though deprecating the altogether inadequate emoluments which are offered in return. This will be found one of the most valuable contributions in the whole volume for those who, having secured an appointment as medical officer of health, wish to have brought before them the whole

requirements, duties, and routine work appertaining to that office.

All those interested in public health can but be grateful for the opportunity, which this valuable and well-bound volume affords, of gaining an excellent and reliable knowledge of the many subjects which it embraces.

The second volume, of which the title is given at the head of this notice, is a third edition, considerably enlarged and improved, of the "Principles of Hygiene,"—a small handbook written by Dr. Willoughby, for the special use of the students of hygiene in the Science and Art Department, South Kensington.

The author very justly infers that with a material increase in its bulk, the scope of its utility has been extended, and that it will now meet the requirements of the medical man, the student, and the teacher. We do not, however, quite agree with the author in his assertion that the contents will be found almost if not quite sufficient for most examinations in public health. The book undoubtedly deals fully enough with the *principles* of hygiene, but the student for diplomas in public health will find it necessary to consult other works upon special subjects—such as Water, Air, and Food Analysis, Offensive Trades, and Sanitary Legislation. We do not wish it to be inferred, however, that Dr. Willoughby's book is inferior in any way to most of the other small manuals dealing with the same subject, neither of which is sufficient in itself to meet the requirements of those seeking public health diplomas. The present volume is well adapted to rank with others of its kind as a very useful manual, and its appearance adds to the difficulty which teachers already experience of concluding as to which is the best all-round book for students bent upon securing a degree in hygiene. This difficulty experienced by teachers arises from the fact that all such manuals are, of necessity from their small bulk, somewhat unequal; in all it is easy to lay one's finger upon some important points which are dismissed far too cursorily. The present volume is no exception in this respect; the chapters on food, school hygiene, and demography are excellent, and probably the best that have yet found their way into any of the smaller public health publications; but, on the other hand, there is practically nothing about offensive trades, with reference to the nature and source of the various nuisances which each gives rise to, and the means by which these can be abated; the subject of the collection, storage, and distribution of water for town supplies might be amplified with advantage; and if it is necessary to introduce the examination of air, surely its importance justifies the author in giving at least two full pages to it.

The manual suffers somewhat from a dearth of illustrations; these are prized highly by the student who comes green to the subject, and Dr. Willoughby would have done well to give more than thirty-nine illustrations in his manual of nearly 500 pages.

In the preface the author writes: "Some of my statements, especially as to cholera, diphtheria, and the influence of small-pox hospitals, may appear somewhat dogmatic and opposed to traditional teaching." But we do not think that the bulk of sanitarians will differ from Dr. Willoughby in the views which he holds upon either of these subjects, and we commend his opposition to traditional teaching when this teaching is not in accordance with more recently acquired knowledge. The work is for the most part very well done, and those interested in the study of public health matters will do well to read it.

Mr. Crookes can be congratulated in so far as he has well translated a work which serves to give us an insight into the German methods of practical hygiene. These methods are for the most part similar to those in vogue in this country, but in many important respects we differ from our neighbours; and it is mainly on this account that the work will not become the text-book for English students of practical hygiene, valuable as it undoubtedly must be to German students.

The book is characterised by what appears to be almost a studied ostracism of everything British. The methods selected and advocated are almost exclusively German, and with very rare exceptions (possibly half a dozen in the two volumes) continental views and opinions are alone given.

In view of the fact that in the preface the author writes: "Thus I hand over my book to the nation which has taken the lead of all modern civilised peoples in the sphere of practical hygiene," it is strange that he should have so persistently ignored everything English in the work. Surely in water-analysis we might reasonably expect to find some mention made of Wanklyn's, Frankland's, or Tidy's processes; and a perusal of the section upon the hygienic examination of dwelling-houses discloses several discrepancies which exist between English and German views on house sanitation Such a sentence, for instance, as "The overflow pipes of cisterns should not open into the soil-pipe of a w.c. without the intervention of a siphon," would certainly not find its way into our sanitary literature. The use throughout the work of the term "typhus" for "typhoid" or "enteric," and the fact that the "degrees" of hardness are always *German* degrees, will certainly create a little confusion among English readers; and here and there are instances where the information is either imperfect or misleading when viewed from the English standpoint. One such instance has already been given, and we now furnish a few others:—

The author writes: "The danger of chronic poisoning by drinking water has probably never existed." He estimates the ammonia by adding the Nessler reagent to the original water, and does not appear to attach sufficient importance to its presence; the indigo process is the only one given for estimating the nitric acid in water; the organic matter in water is alone determined by the amount of oxygen which it will consume, according to Kubel-Tiemann. The microscopical examination of foreign matter in water occupies about a page, and no illustrations are given save of the ova of the more common intestinal parasites. Organic matter in the air is dealt with very cursorily and unsatisfactorily, and the only means of estimating it is by the oxygen which it will absorb from permanganate, which, the writer is at pains to point out, suffers from grave defects. The microscopical characters of the different starch grains are treated in a very poor and insufficient manner. The

tract of the ether vapours in the Soxhlet apparatus is wrongly described, and the treatment of the subject of soil examination is crude.

Although it is not difficult to thus indicate many points with which a critic in this country may find fault, the work may with profit be consulted on many subjects, and none with greater advantage than that of Food.

The book is capitally printed and bound in two handy-sized volumes.

THE LATEST TEXT-BOOK OF GEOLOGY.

Text-Book of Geology. By Sir Archibald Geikie, Director-General of the Geological Survey of Great Britain and Ireland. Third Edition, revised and enlarged. (London: Macmillan and Co., 1893.)

IT goes very much against the grain, for it savours of ingratitude, to begin by picking holes in a book that has been a trusted companion, that has proved itself worthy of trust, and to which I have been so largely indebted, as the volume before me. But the strictures I feel bound to make are not very severe, and the blots I cannot help noticing do not impair seriously the value of the work—do not, indeed, detract at all from its usefulness in the case of a large number of readers.

The first point on which I have always differed from the author is this. In Book i., which deals with the cosmical aspects of geology, we are introduced to some of the darkest and most unsettled problems that arise when we concern ourselves with the earth's history; the stability of its axis, the degree of its rigidity, the causes of the changes of climate which have occurred in bygone days. Besides their obscurity these points have not a little in common, and much may be said in favour of grouping them together. But when we find it stated in the preface that the method of treatment adopted is one which the author has found, while conducting his geological class, to afford the student a good grasp of the general principles of the science, it is hardly possible to avoid doubting the wisdom of bringing them in at so early a stage. To do this is to run counter to that prime canon of teaching, which bids us start with the concrete, simple, and known, and lead thence up to the abstract, complex, and hypothetical. To the advanced student, who has already made the acquaintance of these unsettled points, such a summary as we have here of what has been done towards their solution is most valuable; but it is rather strong meat for the beginner. On just the same grounds I would object to putting in the forefront speculations as to the state of the earth's interior or her age. Something may be said in favour of an early notice of the nebular hypothesis, for it looks like beginning at the beginning. But to do this successfully we must have some certain knowledge of what the beginning was, and this we assuredly have not in the case of the earth. So greatly do I differ from the author's view as expressed in the preface that I always recommend students to omit large portions of Books i. and ii. on their first reading. In the same connection one may note that, on the principle that the father comes before the children, hypogene action precedes epigene action in Book iii. But on grounds already stated, I should be inclined to reverse the order.

Further, while all that style could do to render the work attractive has been done, I have found that the arrangement of its matter tends to render it at times rather hard reading. It is somewhat irritating, when you have begun to grow warm on some subject and want to know everything that is known about it, to be told that no more can be said here, but that some information has been given in a previous book, and that the subject is further discussed in a subsequent book. It is no great hardship to have to turn backwards or forwards, though a little hunting may be required to find the exact passage sought; yet these cross references do act as a check on the even flow of one's thought, and they occur pretty frequently. A little more elasticity and a little less consistency may be desiderated. Take the case of metamorphism. In Book ii. part 7, section iii. we have a description of the chief varieties of metamorphic rocks; then, under the head of Dynamical Geology, in Book iii., instances of the changes produced by metamorphism; lastly, in Book iv., which treats of the architecture of the earth's crust, we are told of some additional metamorphic changes and of the processes by which metamorphism is brought about. It is difficult to see why the last two sections should have been so widely separated for the process of metamorphism, specially of regional metamorphism, is a dynamical operation. It would have been a convenience and would have saved some repetition, to have had all these sections in continuous sequence; and it is instructive to notice how impossible is rigid adherence to systematic arrangement, for even in the descriptive section there are constant anticipations of the dynamical problems which are treated more fully later on.

There are other cases in which, for a similar reason, it will be found troublesome to gather into a connected whole all that the book has to tell on a specific subject; but the trouble will be well repaid, for it is a book almost exhaustive in its fulness, copiously illustrated, lucid in its descriptions, and a model of English in style. As an illustration of its thoroughly practical character, we may point to the minute directions on the subject of fossil-collecting at the end of Book v. On some of the more recondite and obscure problems of geology, the author has wisely refrained from attempting to decide between rival hypotheses; but he has summarised the more important speculative solutions that have been put forward, and has given such full references to the papers in which these appear, that the reader, who is so minded, can easily follow out the questions for himself. Indeed, throughout what may be called the physical side of geology, the book is a most exhaustive and trustworthy compendium, such as could be produced only by one who has a wide acquaintance with the literature of the subject, and who has also been brought face to face with what he describes by life-long and varied work in the field.

When we come to stratigraphical geology, it behoves the critic to be wary in his judgments. To treat this satisfactorily seems to me to be the most trying ordeal to which the writer of a text-book can be subjected. At the very threshold we are met with one of the most perplexing of geological problems, when we are called upon to decide between the rival claims of contemporaneity and homotaxis. The subject is discussed at some length by

our author. A reference to Prof. Huxley's Anniversary Address (*Q. J. Geol. Soc.* xxvi. [1870] p. 43) might be usefully added to the note on p. 658. And when we pass from theoretical questions to matters of actual fact, the treatment of this branch of geology is no less difficult. How often does it consist of little else but tables of names of formations (comparative or otherwise), lists of fossils, and other statistical information, that make it about as lively as a parish register or a regimental roll-list. How often do we ungratefully curse for its dismalness a book of this kind, to which we are glad enough to turn for reference. And at first it looks as if this could not be helped, for if we are to give within reasonable compass only a summary of what is known of the stratigraphy of the world, what space is left for more than dreary statistics? Fortunately there are two matters directly arising out of the bare facts of stratigraphy, which give life to its dry bones: the light which the rocks of a region throw on its physical geography at the time they were formed, and the connection between the fossils of geological epochs and the general evolution of life on the earth. For these space must be found, because without these our narrative is no more geology than a list of dates is history. These points have not been lost sight of in the present text-book.

The oldest rocks of the earth's crust are in the present edition prudently grouped together under the head of pre-Cambrian. Of the many names given to these rocks all but this have involved more or less of unjustifiable assumption; but in this there is comparative safety, for whatever difference of opinion there may be about the upper limit of the Cambrian, there is a fairly general provisional agreement as to where its base is to be placed. The account of the pre-Cambrian rocks has been recast and amplified; the term is not used as a "dumping ground for everything of unknown age," but the claims of the rock groups described under this head to the antiquity which the name implies are canvassed. Additional details as to the recent work of the Geological Survey in the North-west Highlands are introduced. Attention is also called to the fact that portions of the Archæan schists have in more than one locality been shown to be intrusive, and that the amount of the Archæan has thereby been materially reduced. But it must not be overlooked in this connection that the pebbles in the conglomerates of the Torridian and other pre-Cambrian clastic rocks prove the existence of crystalline schists of Archæan type before these beds were deposited, and so leave a residue of Archæan rocks that no future discoveries can abolish. Further additions in the present edition deal with the rocks of the Central Highlands provisionally classed as Dalradian, and the researches of American geologists among their Fundamental Complex and Algonkian. The amount of new matter in this part of the book makes it practically a new work.

Within the space of this article it will not be possible to do more than glance at the many subsequent improvements. The account of the Silurian Rocks of North Wales is hardly up to date, and specially the treatment of the May Hill Beds leaves somewhat to be desired. The insertion of a table giving the results of Prof. Lapworth's work in the Southern Uplands of Scotland is a recognition that all geologists will welcome. The Devonian section is enriched by an account of the researches of Mr. Usher and Prof. Kayser. Under the head of the Carboniferous System the account of the distribution of the fossils of the English coal measures is hardly up to the mark. It is scarcely brought out with sufficient distinctness that the marine shells are found only in a few thin bands, and that these are by no means confined to the Ganister Beds. It is questionable, too, whether it was worth devoting so much space to the attempts of Grand'Eury and others to zone the carboniferous rocks by means of their plants. There are those among us who yet recollect Hooker's warning as to the value of specific distinctions between fossil plants, which has been since enforced by the discovery that two genera so seemingly distinct as Lepidodendron and Halonia are really different parts of the same plant. A most important addition to the Permian section is an account of the marine type of the Permian rocks, which, if I mistake not, now finds for the first time a place in an English text-book. Under the Jurassic section attention is called to Neumayr's speculations as to the climatic belts of that period. Among the Cretaceous deposits due notice is taken of the work of Mr. Lamplugh and Prof. Pavlow on the Specton Clay. The treatment of the Gault and Upper Greensand is hardly satisfactory. The views as to the relationship of these two groups, by no means new but largely enforced by the work of Mr. Jukes-Browne, are only indicated; and the reader will hardly gather that, as is stated so unhesitatingly in the last report of the Director-General of the Geological Survey, the two groups really constitute one formation. Have red-tape regulations here forbidden the author to give to the public the benefit of survey discoveries till they have been announced in an official form? This seems a pity, but red-tape is hardly likely to see it in this light. In the Gossau Beds we find a striking instance of the difficulty of keeping a book up to date; not many weeks have passed since a paper was read before the Geological Society, which will probably largely increase our knowledge of this somewhat exceptional formation. One very useful addition among the Tertiary Rocks is a fuller notice of Mr. Clement Reid's studies of the Cromer section.

The last book, on Physiographical Geology, is a little disappointing. The author has made earth-sculpture and other branches of this division of geology so specially his own, that we could have wished for more under this head than the concise summary he has given. True, he would have been repeating what he has said oftentimes before; but his contributions to this most fascinating subject are rather scattered, and a full summary would have been very welcome.

The above notes, which are not the result of a systematic collation of this and the previous edition, but have been culled at random, suffice to show that no pains have been spared to bring before the reader the latest results of geological inquiry. In a rapidly growing science the task of keeping edition after edition of a text-book up to date must be toilsome; it is fortunate when we have an author who has the courage to stick to the work, and power to carry it out with success. It is a welcome fact that this third edition, in spite of its 150 additional pages, is less bulky than the second.

A. H. GREEN.

THE CHEMISTRY OF THE BLOOD.

On the Chemistry of the Blood, and other Scientific Papers. By the late L. C. Wooldridge, M.D., D.Sc., Assistant Physician to, and co-Lecturer on Physiology at Guy's Hospital. Arranged by Victor Horsley, F.R.S., and Ernest Starling, M.D., with an introduction by Victor Horsley (London: Kegan Paul, Trench, Trübner, and Co., Ltd., 1893.)

TO all who are interested in the progress of medical science and of physiology, the publication of the scientific papers of the late Dr. Wooldridge will be very welcome. Dr. Wooldridge always impressed those who knew him well as possessing many of the attributes of genius. Full of ideas in connection with the subject he chose for his work (chemical physiology), he was not content to limit himself to the expression of ideas simply, but resorted to experiment to test the accuracy of his conceptions. The experiments and observations which he made, it may be said, dealt with one of the most complicated subjects in physiology, viz. the chemistry of the substances (proteids) closely related to the life of the cell and of the organism. A man of Dr. Wooldridge's capacity and originality could not long remain trammelled by the traditions of academic science. Although he received a very full academic training (and his early original work on the blood bears the impress of this training), he soon discovered new paths of research, and elucidated facts combating old ideas, and shedding light on the phenomena of life. It was perhaps inevitable that so original a man should come into conflict with what may be called the "academic mind"; the man of great originality always does. What happened to Dr. Wooldridge in this respect is stated very clearly, and not too forcibly, in the excellent introduction to this volume by Prof. Victor Horsley. It is only necessary here to state that although Wooldridge's work was appreciated on the continent, his Croonian lecture, embodying his views on the coagulation of the blood, was refused publication by the Royal Society. It is not wise, perhaps, to lay too much stress on this error of judgment, but it may be said that Wooldridge did not publish papers containing visionary ideas, but all his conclusions were based on well-conducted experiments, and that he was a modest and sincere seeker after truth. His work, in spite of the drawbacks and disappointments of his short life, is now beginning to be appreciated, and in two or three directions he led the way to discoveries which are of great importance to physiological and pathological science.

It would be out of place here to give anything like a full synopsis of the scientific work done by Wooldridge. It may be said that his chief work dealt with the phenomena of the coagulation of the blood: phenomena clearly showing the passage of a living tissue into a dead. The investigation of such phenomena is in many respects more difficult and complicated than a purely physical or chemical research; for in a chemical study of so complicated a liquid as the living blood, the mere separation of one of its constituents may so alter its nature as to lead to a misapprehension of its real properties. This was clear to Wooldridge during the whole course of his work. The phenomena of the coagulation of the blood was explained by Alexander Schmidt and his pupils of the Dorpat school, as consisting in the action of a "ferment" on a proteid body called fibrinogen; the chief change in the blood preceding the formation of fibrin being a destruction of the white corpuscles. This theory was taught in the schools, and accepted not as a final explanation, but as a very probable explanation, the chief idea being that a "ferment" was essential to produce coagulation. Now Wooldridge showed conclusively by his experiments that a ferment is not necessary to coagulation; he, in fact, separated from the blood plasma a fibrinogen which became transformed into fibrin without the aid of a ferment. This change he found in many cases was accelerated by lecithin. Wooldridge viewed coagulation as a change occurring in the plasma of the blood, and not so much in the white corpuscles; his ideas, therefore, were in direct opposition to those of the Dorpat school, and have been in part confirmed by subsequent researches. For all the details of his work in this respect, his papers must be consulted; mention must, however, be made of his brilliant discovery of a means of causing intra-vascular coagulation.

It was known that by injecting a solution of peptone into the circulation of certain animals the coagulation of the blood was prevented when drawn from the body. No method was known by which the blood could be made to coagulate in the vessels during life. Wooldridge discovered that the injection of an extract of certain parts of the body, *e.g.* the thymus gland, the testis, and lymphatic glands, produced this. It is impossible to overestimate this result, since it throws light on the phenomena of coagulation occurring in the vessels in many cases of disease. The body producing this effect is a proteid and called "tissue-fibrinogen." His study of this body, or bodies (for there may be several closely allied), induced Wooldridge, when he began to do work for the Medical Officer of the Local Government Board, to see whether it possessed any immunizing properties; whether, in fact, the profound change it produced in the blood was unfavourable to the development of bacteria invading the body. He found that in the case of the bacillus anthracis that it had this property; that in rabbits injected with this tissue fibrinogen the death from anthrax (inoculated at the same time) was delayed. Moreover, he found that he could produce a better result if the bacilli were grown for a short time in a solution of tissue fibrinogen. There is no doubt that Wooldridge, in these experiments, was the first worker who clearly showed the possibility of chemical vaccination for infective disorders; and there is but little doubt that if he had lived to continue this work, he would have clearly demonstrated what others have since shown, viz. vaccination against a bacterial disease by means of the chemical products of the specific micro-organism.

Sufficient has been said to show what the well-arranged volume under consideration demonstrates at length—that Wooldridge's work was of the highest order; and it was fitting that his scientific papers should be arranged by Prof. Victor Horsley, who was Professor-Superintendent of the Brown Institution when Wooldridge did much of his work there, and by Dr. Ernest Starling, who succeeded him as co-Lecturer at Guy's Hospital.

AGRICULTURAL BOTANY FOR EXTENSIONISTS.

An Elementary Text-Book on Agricultural Botany. By M. C. Potter, M.A. Small 8vo. Pp. 250, with ninety-nine illustrations in the text. (London: Methuen and Co., 1893.)

THIS is a very good little book up to a certain point, but it is neither better nor worse than the general run of elementary works on botany, in which there is an attempt to cover the whole field. The physiological and anatomical parts are the best; yet we see no reason why the title should be "Agricultural Botany." Indeed, we fear the author has been a little too ambitious; laudably ambitious, perhaps, though wanting the practical knowledge necessary to achieve his object—not that it is one within easy reach. This is an extract from his preface: "My aim in these few pages has been to lay a foundation which may serve to guide the future operations in the field, and form a basis for intelligent trial and experiment. In these days of competition and struggle for existence, every little tells, and the farmer who, understanding, can apply his knowledge, is more likely to succeed than one who labours without the advantage of this knowledge."

No doubt a man would not necessarily be a worse farmer because he possessed some knowledge of vegetable physiology, nutrition, or even classification, and he might possibly derive a more intelligent enjoyment—if there be any left—from his occupation; but if he knew all the botany in Mr. Potter's book, and all that is not in his book, we doubt whether he would be any nearer making farming pay, which is the main object, after all, of the majority of those who engage in the pursuit. Success in farming does not depend so much on scientific knowledge as on practical knowledge. Science has doubtless done much to advance farming—especially mechanical science; and we should be the last to discourage making botany a subject of study for the budding farmer. But we think the macroscopic side is too much neglected in favour of the microscopic side. For instance, we sought the distinctions between rye (*Secale*) and barley (*Hordeum*); but although the anatomical structure of the stem of the former is described and illustrated in some detail, it is not included in the chapter on grasses where the floral structure is described. In the description of the natural order Leguminosæ, it is stated that the fruit is always composed of a single carple; that the leaves are never opposite; and that the seeds are always destitute of endosperm. It is unnecessary to give examples disproving these statements. On the next page the flowers of the sub-order Cœsalpinæe (*sic*) are said to resemble the Papilionaceæ, but to differ in having the standard inside the wings. There is one element of truth in this. The nature and extent of the information given under some of the genera of Leguminosæ may be gathered from the following: *Sarothamnus*—the broom is common on sandy waste lands. *Ononis*—a small plant with pink flower, commonly known as the rest harrow. There are two species, one with spines and one without. Looking under *Pisum*, we discover that *P. arvense*, the field pea, is not mentioned. Under *Vicia*, the tare, *V. sativa*, is described as having a weak stem, partly erect, and purple flowers, often in pairs; with the further information that it is often cultivated. In short, this part of the book needs thorough revision before it can be considered as useful or satisfactory. At half a dozen other places where we opened the pages, we noticed the same incompleteness and want of precision.

THE PRINCIPLES OF HOSPITAL CONSTRUCTION.

Healthy Hospitals: Observations on some Points connected with Hospital Construction. By Sir Douglas Galton, K.C.B., F.R.S., &c. (Oxford: The Clarendon Press.)

THE object of this book, as its author, Sir Douglas Galton, tells us, is to bring together the principles of hospital construction which now lie scattered through various publications, and to show what points are essential to health in hospital establishments. This task has been admirably fulfilled by the author, and we cannot but recognise the skilful manner in which, from chaos he has brought together and condensed in the small compass of 282 pages such a vast amount of useful information.

Sir Douglas Galton has already a high reputation for the application of scientific methods to the construction of barracks and hospitals. Few men have had larger opportunities of acquiring such knowledge in the public service, and very few have been able to investigate the questions involved so thoroughly as the author of "Healthy Hospitals," whose zeal has induced him to visit every place, as well in America as on the continent, where he could obtain sound practical knowledge on the subject by personal observation and inquiry. We therefore gladly welcome this book, which is the outcome of his great experience.

In the preliminary chapter Sir Douglas Galton enters very briefly into the historical part of his subject, and dates the great improvement in the construction of hospitals from the close of the Crimean War, the American War of Secession, and the Franco-German War of 1870-71.

He subsequently lays down the first principles on which the successful treatment of disease depends, the selection of site, the conditions of air supply, of warming, lighting, and water supply. Many of the rules laid down are of course not new, but they are nevertheless valuable, and bear to be repeated and emphasised.

The rules to be followed are defined so clearly and concisely, that it becomes a simple matter to apply them in a practical form. The chapter on site is one that will at a glance show the importance of the subject, and at the same time the difficulties it often has to contend with. Many errors are pointed out which have been committed in the selection of plans for some of the large hospitals in England and on the continent. This is one of the most important and best chapters in the work before us.

In the chapters on the constitution and movements of the air, and on ventilation and warming, which are dependent in a great degree on these changes, the author enters very fully into the consideration of these important subjects. He accepts De Chaumont's standard as the

best guarantee for keeping an air space pure and wholesome—a point of no small importance, since latterly a lower standard has been advocated. He recognises the importance of investigating the micro-organisms in air, but states "that our knowledge of this science and of the nature of the organisms is too recent to allow us to lay down any fixed rules for judging of what are dangerous characteristics of air in wards measured by this standard." This is no doubt true up to a certain point, but the Ratio $\frac{\text{Bacteria}}{\text{Moulds}}$ as pointed out by Carnelly and Haldane (*Philosophical Transactions of the Royal Society*, 1887), should not be overlooked in investigations on this point.

The chapters on warming and lighting are complete monographs on these subjects, as we might expect from the distinguished author who has made them his special study.

In discussing the various methods of ventilation which have been applied to hospitals, is mentioned the mechanical extraction of air as practised by propulsion. This plan has never found favour in England, but has been introduced into some continental hospitals. We note that on several occasions when three of the most important hospitals were visited in Europe and the United States, in which ventilation depended on propulsion, on every occasion the propulsion happened to be out of use for the time; in some cases evidently with the object of saving the expense of fuel!

The latter chapters are devoted to the consideration of the ward unit and the administration buildings. Every detail has been most carefully noted, and the closest criticism fails to find an omission. The rules are laid down with a simplicity and clearness which render it very difficult to notice them without quoting them in detail, and the plans which accompany the letter-press show at a glance the principles which should be followed.

We regret that the writer has not entered more fully into the question connected with isolation hospitals for infectious diseases. No plan is given of any such hospital, although mention is made of the Local Government Board rules for the London fever hospitals.

The isolation pavilion of the Johns Hopkins' Hospital seems to be so admirably constructed, and the structural details so carefully carried out, that the plan would be a valuable addition to the present work. In infectious hospitals, the position of the administration block to the wards would also differ to the plan usually adopted for general hospitals.

Sir Douglas Galton is opposed to the expense which some of the costly and palatial hospitals of the present day have entailed, and advocates simplicity of design and economy in construction as leading conditions to be observed in building hospitals for the future. If the rules he has so clearly given throughout his work be attended to, these important qualities will naturally follow.

We commend this book not only to the architect and sanitarian, but to all interested in hospital work. It is eminently practical, and its author must be congratulated on the completion of a work of no ordinary merit, and one which is a fitting companion volume to his "Healthy Homes.'

OUR BOOK SHELF.

The Vault of Heaven. By Richard A. Gregory, F.R.A.S. (London: Methuen and Co., 1893.)

THE aim of this volume of the University Extension Series of text-books is to give "an elementary account of some of the marvels that have been revealed by the use of the telescope and two of its most indispensable adjuncts,—the spectroscope and the photographic camera." In the space of about 180 pages the author contrives to give an admirable introduction to the study of modern physical astronomy, and the whole is set forth in a manner calculated to awaken a permanent interest in this most fascinating subject. The book is eminently readable, and contains none of the mathematical expressions which are so liable to arrest the progress of the general reader. Astronomical telescopes, including equatorials and meridian instruments, form the subject of the first chapter. Then follow two chapters giving an excellent account of the sun and of the various methods by which our knowledge of that luminary has been gradually accumulated. The reader is next presented with bright and brief pictures of the moon and planets, comets and shooting-stars, and of the various bodies which are met with as we proceed further outwards into "boundless space." The "Chemistry of Stars and Nebulæ," and "Celestial Photography," define the scope of the final chapters. Many novel illustrations are given to assist the reader in comprehending the significance of astronomical data. The subject-matter is quite up-to-date, and in matters not yet quite clear the author has wisely refrained from taking sides in controversies. The historical references are fairly complete, and space is found for some most interesting extracts and diagrams from Galileo's "Sidereal Messenger," published in 1610.

Where all the various parts of the subject are so well explained, it is difficult to single out points for special mention, but we may say that the author is particularly successful in his treatment of celestial photography, though we cannot help regretting that more is not said about the immense gain to astronomy which has followed from the application of photography to the study of the spectra of the heavenly bodies. We are glad to see, however, that he says (p. 33) with regard to the Carrington-Hodgson observation of 1859, "the statement that the outburst was *immediately* followed by a magnetic storm does not appear to be founded on fact. From an examination of the magnetic records kept at Kew, it appears that at the time of the observation the needles were unaffected, and it was not until *fifteen hours* after that a magnetic storm occurred."

A word of praise is due to the author for the careful preparation and selection of diagrams and photographs, all of which are excellently reproduced; many of them make their first appearance in this volume. There are a few misprints—as, for instance, on p. 113, where 14 times 60,000 is given as 84,000; but they are not so serious as to be misleading. A classified list of astronomical books for the use of those desiring to extend their reading beyond the limits of an introductory text-book, concludes a volume which is well adapted to impart the preliminary knowledge essential for a proper understanding and appreciation of the fresh results which are constantly being obtained in the various observatories throughout the world.

A Journey through the Yemen, and some General Remarks upon that Country. By Walter B. Harris, F.R.G.S. (Edinburgh and London: William Blackwood and Sons, 1893.)

THE Yemen is an indefinite tract stretching inland from the south-western corner of Arabia, and the "general remarks" upon its geography and history are placed first in this volume, the personal narrative of the author's

journey, in which alone is there any original information, occupying the second place. From Aden Mr. Harris started inland and crossed the Turkish frontier under the pretence of being a Greek shopkeeper from Port Said. In this way he obtained access to the disaffected province of Yemen during the progress of a rebellion, reached Sanaa, and was naturally imprisoned by the Turkish officials there, who refused to recognise his English passport. The author finds fault with the Foreign Office for not coming to his rescue, apparently forgetful that he wilfully concealed his nationality at the outset, and so gave rise to suspicion, and forfeited any privileges to which it might entitle him. From Sanaa he was sent under escort to Hodeida. The illustrations are interesting as types of the scenery and people of the Yemen, but the book has no other claim to scientific notice.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Directorship of the British Institute of Preventive Medicine.

WE observe in your issue of the 18th inst. a letter, signed by Prof. Roy, respecting the appointment of a "Director" to the Institute of Preventive Medicine, and purporting to recount what occurred at the meetings of the Council.

As Prof. Roy has misstated the principal facts, and has withheld others which are fatal to his allegations, it is possible that some of your readers may be misled, and it is therefore advisable that the real state of the matter should be published.

(1) The present appointment being one of a purely temporary nature (for three years only) and at a nominal salary, is not, as Prof. Roy implies, equal to that of Dr. Koch, neither is it to that of M. Pasteur, who, by the way, is not, as Prof. Roy implies, the Director of the Pasteur Institute.

(2) The qualifications necessary for the office were fully considered by the Council, and by committees of the Council, and consequently Prof. Roy's statements to the contrary are not correct.

(3) Prof. Roy's statement that he initiated the idea of the Institute is not according to the fact. He was entrusted with moving the resolution proposing the establishment, at the meeting where the matter was first publicly discussed, but the founding of the Institute had been in the minds of the members of the Mansion House Committee and discussed among them long before.

(4) Prof. Roy implies that he resigned his position as secretary to the Council (*sic*) as a kind of protest against the latter's mode of transacting business.

This statement is incorrect. In the first place, Prof. Roy was one of the secretaries to the Executive Committee, and not to the Council. In the second place, Prof. Roy resigned that position without making any protest whatever to the committee, by whom his resignation was at once and unconditionally accepted.

(5) The subject of the temporary directorship was discussed by "gentlemen who are" or have been "directors of laboratories." Prof. Roy implies it was not so discussed by experts. The error of this allegation is probably due to the fact that he was absent from the Council meeting at which the question was first brought up, and that he was not a member of any committee. It may be noted that Prof. Roy complains of non-attendances. On this point his statement may at once be conceded so far as he personally is concerned, since in 1893 he attended but three meetings.

(6) The question of appointment of a temporary Director was stated on December 13 to be urgent, and the urgency was admitted by the whole Council with the exception of Prof. Roy. Prof. Roy tells your readers that the statement "carried no weight with him." Possibly this may have been because he was absent from the previous Council meeting when the point of urgency was fully discussed; but such ignorance, even if admitted to be an excuse, does not account for Prof. Roy now withholding the fact that when he was present on the 13th ult. the reason of the urgency was fully communicated to him. Also, it is not right for him to withhold, as he does, the fact that the acceptance of the report of the sub-committee, which was wholly conditioned by that urgency, was agreed to by the Council *nem. con.*

(7) Prof. Roy speaks as though the Council strongly objected to the resolutions laid before it. He ignores the fact that on the 13th it was but two members, including himself, and on the 19th only himself, who so objected.

(8) Prof. Roy suppresses the fact that a special meeting of the Council was held on December 19 to re-examine the whole question, and to confirm or reject the minutes of the meeting of December 13, and that those minutes were circulated to every member of the Council, and that the meetings of the 13th and 19th were well attended. He omits to mention that he circulated beforehand, and produced at the meeting on the 19th, a document which he termed a "protest," and that, as it contained offensive statements plainly contrary to fact, the Council declined to proceed with the business of the meeting until Prof. Roy withdrew his "protest" unconditionally. He also suppresses the fact that he did so, and that this preliminary having been executed, the minutes of December 13 were then put and confirmed *nem. con.*

If any of your readers, after this historical statement, consider that Prof. Roy's letter is justified in any sense, further information can be supplied.

In conclusion, it may perhaps be interesting to note the names of those present on December 19. These were, for the appointment of the temporary Director—Sir Joseph Lister (chairman), Sir Henry Roscoe, Sir Joseph Fayrer, Prof. Burdon Sanderson, Prof. Michael Foster, Prof. Victor Horsley, Mr. Watson Cheyne; while there was opposed to the appointment —Prof. Roy.

J. FAYRER,
VICTOR HORSLEY,
Mover and seconder of the motion for confirmation of the minutes of December 13.

The Origin of Rock Basins.

IN my previous letter I confined myself to one aspect of the controversy relative to the origin of rock basins now occupied by lakes, as all the other arguments adduced by Dr. Wallace—with one exception, of which more hereafter—have already been answered, and the case on either side so fully presented that each one may draw his own conclusions as to which is right. The particular confusion of argument I referred to has not been so fully dealt with, and Dr. Wallace's letter shows that it was one which required to be met, for the heading of his letter itself shows that he has not fully appreciated the particular point at issue, which is the cause of origin of rock basins irrespective of whether they are or have ever been occupied by lakes. Leaving out of question the opinions of other opponents of the glacial erosion theory of the origin of lakes, as this would introduce too large a subject for the correspondence columns of NATURE, and confining myself to the defence of the views put forth in my former letter, I may point out that the preglacial origin of rock basins by deformation is by no means the strongest form of the alternative explanation; on the contrary, it appears to me to be subject to nearly as many objections as the hypothesis of glacial erosion of rock basins. If a rock basin is produced by deformation in a region where the valleys are not filled by glaciers, the ordinary action of the streams will usually be able to prevent a lake from being produced by the erosion of the barrier, the filling up of the hollow, or both combined. When, however, a rock basin is formed by differential movements in a glacier filled valley, it would be filled with ice, and so protected from sedimentation, and on the retreat of the glacier would at first be filled with water, and only gradually filled with solid matter, while the stream, having deposited its solid burden in the lake, would be unable to exert any erosive action on the barrier. From this it appears that there is a probability that rock basins formed beneath the glaciers during their extension in the glacial period should remain to the present day as lakes only partially filled up by solid *débris*.

Seeing then that there is an inherent probability that rock basins formed in non-glaciated regions would never become

lakes, except when the movements were unusually rapid or extensive, the argument from geographical distribution fails; for we have no evidence to show whether rock basins are more or less abundant in regions that have been glaciated, than in those that have not; and seeing, further, that differential movements are known to take place, while it has never been proved that a glacier is physically capable of excavating a rock basin, the *onus probandi* rests with the advocates of the glacial theory; and until they have shown that rock basins are less common in regions that have been glaciated than in those that have not, this argument is not logically admissible. Observations on this point are very desirable, but it must be remembered that filled up lake basins are not the only thing to be looked for; what is desired is evidence of the production of rock basins, or of such differential movements as would have led to their formation, had the erosion of the barrier been less rapid. In the Himalayas such rock basins appear to have been formed in quite as great abundance as in the mountains of Europe, and to correspond with them in position and form; but the elevation of the mountains has been so recent, and the rainfall is so great, that the processes of nature are more rapid than in Europe, and the rock basins have consequently not only been filled up, but the barrier has afterwards in many cases been destroyed, and the deposits largely removed by erosion, so that the fact of their having originally been accumulated in a rock basin is not always easily recognisable.

The one new argument of Dr. Wallace's is that derived from the supposed difference between the outlines of existing lakes and those that would result from the submergence of river valleys. In the selected instances, however, he has compared mountain lakes with submerged lowland valleys instead of with mountain valleys. In the latter, long stretches are frequently found where the slopes of the beds of the side streams are much steeper than that of the main valley; these valleys if submerged would give rise to lakes of great length in comparison with their breadth, and without the numerous deep embayments of the shore line which would be usually found in a submerged lowland valley. As a single easily verified instance to show that a submerged mountain valley need not have numerous deep bays, I may instance the Pangong lake in the Himalayas, which will be found on any good map of India, and is nothing more than a submerged subaërially formed river valley; on a smaller scale the Malwa Tal near Naini Tal and the Pil lake in the hills east of Quetta, both of which are river valleys dammed by landslips, have simple outlines without any embayments. The instances I have chosen are from regions where there has not been a great extension of the glaciers, and where the form of the valley before its submergence was entirely produced by subaërial denudation.

R. D. OLDHAM.

On the Change of Superficial Tension of Solid-Liquid Surfaces with Temperature.

IN a recent very interesting communication to the Birmingham Phil. Soc. (*Bir. Phil. Soc. Proc.*, vol. ix. part 1, 1893), upon the effect of a solid in concentrating a substance out of a solution into the superficial film in accordance with Prof. J. J. Thomson's investigation ("Applications of Dynamics to Physics," p. 191), Dr. Gore has quoted an observation of Pouillet's (*Annales de Chemie*, 1822, vol. xx. pp. 141–162), that when inert powders like silica are mixed with liquids that do not act on them heat is evolved. On the other hand, when the superficial area of contact between a liquid and its gas is increased heat is absorbed. This latter is known to be the case because the superficial tension diminishes with rise of temperature. In the case of the solid-liquid surface being produced, it would appear at first sight to follow that the superficial tension should increase with increased temperature. The matter is, however, somewhat more complicated. When a dry solid is mixed with a liquid we are substituting a solid-liquid surface for a solid-air surface, and from the fact that most liquids soak *up* into a mass of dry powder, we may conclude that the superficial potential energy of the solid-liquid is less than that of the solid-air surface, *i.e.* that more work must be done to separate the liquid from the solid than is developed by the air getting at the solid. *If these actions are reversible*, we may apply the laws of thermodynamics, and conclude that as heat is evolved when the system does work, *i.e.* when the solid-liquid surface is increased, that it must require more work to separate the solid from the liquid at high temperatures than at low ones, and in the case of silica and water, for instance, that is very much what one would expect from the action of water at very high temperatures on silica. If we could assume that the superficial tension of air-solid were zero, it would follow from this that the superficial tension of a solid-liquid surface is negative, *i.e.* that there is a superficial pressure, and that the liquid has more attraction for the solid than for its own particles, and that this difference increases with increased temperature, *i.e.* the superficial pressure increases.

The whole subject deserves careful investigation and quantitative treatment, but the difficulty of measuring the superficial tensions of solid-liquid surfaces seems almost insurmountable, so that it would be very difficult to verify the theory. Perhaps something might be done with finely divided liquids that did not mix, and whose superficial tensions might be measured.

Trinity College, Dublin. GEO. FRAS. FITZGERALD.

A Lecture Experiment.

WHEN charcoal, which has been allowed to absorb as much sulphuretted hydrogen as it can take up, is introduced into oxygen gas, the charcoal will burst into flame owing to the energy of the action of the oxygen upon the sulphuretted hydrogen.

This fact is stated in most text-books on chemistry, but no description that I have ever seen of this experiment is calculated to bring about the effect with certainty. The following is a simple method for illustrating this reaction upon the lecture table, which I have never found to fail:—

A few grammes (from five to ten) of powdered charcoal are introduced into a bulb which is blown in the middle of a piece of combustion tube about twenty-five centimetres long. A gentle stream of coal gas is then passed over the charcoal, which is heated by means of a bunsen lamp until it is perfectly dry. This point may be ascertained by allowing the issuing gas to impinge upon a small piece of mirror, and when no further deposition of moisture takes place the charcoal may be considered to be dry, and the heating may be stopped. The charcoal is then allowed to cool in the stream of coal gas until its temperature is so far reduced that the bulb can just be grasped by the hand, when the coal gas is replaced by a stream of sulphuretted hydrogen. The sulphuretted hydrogen should be passed over the charcoal for not less than fifteen minutes, by which time the bulb and its contents will be perfectly cold, and the charcoal will have saturated itself with the gas. (In practice it will be found convenient to prepare the experiment to this stage, and allow a very slow stream of sulphuretted hydrogen to continue passing through the apparatus until the experiment is to be performed.) The supply of sulphuretted hydrogen is then cut off, and a stream of oxygen passed through the tube. Almost immediately the charcoal will become hot, and moisture will be deposited upon the glass. The supply of oxygen should be sufficiently brisk to carry the moisture forward from the charcoal, but not so rapid as to prevent it from condensing on the glass tube beyond the bulb. In a few moments the temperature of the charcoal will rise to the ignition point, when it will inflame and continue to burn in the supply of oxygen.

G. S. NEWTH.

Royal College of Science, London.

PIERRE JOSEPH VAN BENEDEN.

THIS distinguished Belgian zoologist was born on December 19, 1809, at Malines, in the province of Antwerp, a town once well known for its extensive manufacture of lace. He received an excellent education, and early showed a decided taste for natural history; his native town being built on the borders of a tidal river, his attention was soon called to the examination of the littoral fauna of Belgium, though it will be remembered that Belgium only evolved itself into a kingdom in the year 1830, when Beneden came of age. His first promotion was to the keepership of the Natural History Collections at Louvain, and in 1835 he was made an assistant professor in the University of Gand, a post which he appears to have held for only one Term, as we find him in the same

year professor of the Catholic University at Louvain, which professorship he continued to fill for more than half a century. Van Beneden belonged to a generation of zoologists that connected Cuvier with the present age, and followed so far in this great master's steps, that they worked at almost all the branches of the animal kingdom. If we were to give a summary of the very extensive writings of van Beneden we should begin with his memoirs on apes, seals, whales, and so through the various classes, with perhaps the exception of the birds and reptiles, to the gregarines. Circumstances made him devote a great deal of attention to the groups of parasitic worms and Annelides. Most of his papers on these forms were communicated to the Brussels Academy of Sciences or to the Paris Academy; the latter we find reported on by Quatrefages. He took a leading part in the, at one time, exciting controversy about the "alternation of generations," with the elder Sars, D'Udekem, and others.

Among the more important works of Beneden may be mentioned "The Natural History of the Fresh-water Polyzoa," in collaboration with Du Mortier, published in 1850, which obtained the Grand Prize of the Paris Academy; the "Zoologie Médicale," in 1859, of which Paul Gervais was joint author; the "Recherches sur la Faune Littorale de Belgique" (Polypes), in 1866. In connection with this work it may be mentioned that Beneden's artistic powers were quite remarkable, and that many of his memoirs owe a great deal to his excellent illustrations. A good correspondent, he kept himself acquainted with the work of most of his contemporaries, and he was the writer of many of the short biographical sketches referring to zoologists that appeared from year to year in the Reports of the Brussels Academy. Some of our readers may remember what an active part he took in the Liverpool (1870) meeting of the British Association; Rolleston was president of the biological section, and gave a morning to the discussion of the subject of "commensalism," which at that time Beneden's mind was occupied with, and about which he afterwards (1875) published a volume in the "Bibliothèque Scientifique Internationale," that has been translated into German and English. Peradventure some too may remember how delighted Beneden, with Stricker, Dohrn, and some of the other "foreigners" present at that meeting were, to find that a little nucleus of the great body combined to make the "Association Sunday" as little sad as possible by the practice of a proper commensalism. Full of honour after a long life well and usefully spent, Beneden had the additional reward of seeing his son Edward take a high rank in the modern biological school, in this resembling his great contemporary Henri Milne Edwards. Beneden was a member of very many of the Academies and Societies of Europe, and was an honorary LL.D. of the University of Edinburgh. He died at Louvain on January 8, 1894.

THE GREAT GALE OF NOVEMBER 16–20.

THE past autumn and early winter were especially characterised by a mild and humid atmosphere, due to the very marked prevalence of south-westerly winds which have blown with great persistence from the Atlantic. These conditions are without doubt intimately associated with the frequency with which gales have occurred.

The violent storm which was experienced over the entire area of the United Kingdom, as well as over the sea and the parts of the continent adjacent to our islands, from November 16 to 20, was more severe than the other gales which have recently occurred, and it is necessary to refer back many years before a storm so violent and so destructive can be found to have traversed the country.

Prior to the advent of the storm an anticyclonic area, with fairly high barometer readings, was situated over our islands, and north-easterly winds were prevalent. On November 14 and 15 a small cyclonic disturbance travelled over the south-western portion of the kingdom, and caused a general giving way in the area of high barometer readings, while the large anticyclone over Europe also materially decreased in its energy. At this time a large cyclonic disturbance was out in the Atlantic, and was rapidly approaching our western coasts; the first intimation of a renewal of bad weather was shown by a fresh fall of the barometer which set in at Valencia at 4 p.m. 15th, and an hour or so later the wind was freshening from the south-east.

On November 16 the conditions had so far changed that at eight o'clock in the morning the weather chart prepared by the Meteorological Office gave unmistakable indications of an important disturbance at no great distance from the Irish coast, and the Official Weather Report has the following remark:—"A large depression is approaching our western coasts from the south-westward, and is likely to cause rough wet weather over the kingdom generally, especially in the west and north." At this time a strong south-easterly wind was blowing in the south-west, but the force of the wind had not attained to that of a fresh gale (force eight of Beaufort notation) in any part of the United Kingdom, although the wind, which on the previous day had been north-easterly, was now everywhere southerly. The self-recording barograph at Valencia shows that the lowest barometer occurred at 7 p.m. 16th, and between eight and nine in the evening the wind shifted from east by south to west-south-west. The central area of the storm was not far distant from Valencia at this time, and during the succeeding night it traversed Ireland in a direction from south-west to north-east, the whole storm-system progressing at the rate of of about twenty-five geographical miles an hour. By the morning of November 17 the heart of the storm had reached the west of Scotland, the lowest barometer reading reported to the Meteorological Office being 28·53 ins. at Ardrossan. Strong gales had blown during the preceding night in the north and west, and the force of a gale was still reported at many places on our coasts, while the wind had shifted to the north-westward over Ireland. The weather information for the evening of the 17th shows that the storm had continued its course to the north-eastward, and at six o'clock the centre of the disturbance was not far from Wick, where the barometer was 28·57 ins. The north-westerly gale was still blowing over the western portion of the kingdom, but there was a decided lull in the strength of the wind in the east and south-east of England. It was shortly after this time that the greatest violence of the storm burst suddenly over the northern part of the country, and at Deerness, in the Orkneys, the wind at 6 p.m. shifted suddenly from east by north to north by east.

The subsequent track of the storm had a most important influence on the increased violence of the wind, and there seems no reason to suppose that if the disturbance had continued its north-easterly track the gales experienced would have been at all unusual. A very important change in the distribution of atmospheric pressure was in progress over Western Europe, and the change of track and subsequent violence is clearly to be traced to these barometer changes. The anticyclone over Central Russia, which had given way for the small disturbance which first traversed the southern portion of England on the 14th and 15th, was now reasserting itself, and this formed a most effectual barrier to the further north-easterly progress of the storm. In addition to

this, the "ridge" of high barometer which was following the storm was of a very pronounced character, and caused a rapid recovery of pressure in the rear of the disturbance. As the result of these two regions of high barometer, or anticyclones, between which the storm system, or cyclone, was situated, the central area of the storm was brought to bay, and abruptly struck out on a path to the south-eastward, in which direction there was the least resistance to its progress. This halting and indecision and abrupt change of path on the part of the storm area caused the high pressure system in the rear to considerably gain on it, with the result that exceptionally steep gradients were caused for northerly gales, which continued to blow for a period of two or three days over our islands.

The diagram showing the barometer and wind for 8 a.m. November 18, indicates a decided change in the course of the disturbance, and at that hour the lowest barometer was 28·99 inches at Spurn Head, the centre of the disturbance being situated about 50 miles to the east of Scarborough, and travelling south-eastwards down our east coast. On the 19th the disturbance had reached Cuxhaven, where the barometer was reading 29·10 inches, and on the 20th it was passing away over central Europe, but gales were still blowing in the south-east of England and in parts of the North Sea.

The following table shows the strength of the wind in miles per hour as recorded by the velocity anemometers under the supervision of the Meteorological Council, who have kindly allowed access to the anemographs and tabulations:—

November 16, 10 *a.m.*, *to November* 20, 9 *p.m.*—4½ *Days.*

Station.	Maximum velocity.			Hours with velocity 45 miles and above. Force 8 of Beaufort notation.	Mean hourly velocity for 4½ days.
	Miles.	Direction.	Rate.		
Valencia	60	N.N.W. N.W.	18 4 a.m.	31	33
Scilly	66	N.W.b.N.	18 { 2 a.m. 6 a.m. }	41	41
Holyhead ...	89	N.b.W.	18 11 a.m.	76	54
Orkney	96	N.	17 9 p.m.	40	39
North Shields	69	N.	18 { 9 a.m. 10 a.m. }	16	33
Yarmouth ...	64	N.E.b.N.	20 5 a.m.	31	33
Kew	38	N.N.W.	18 7 p.m	0	23

The factor 3 is used with all the anemometers for obtaining the velocity of the wind.

The hourly velocity at Orkney was 90 miles or above for 5 consecutive hours—from 9 p.m. 17th, to 1 a.m. 18th—and both this and the maximum velocity of 96 miles in the hour is in excess of any previous record in this country, the highest velocity in the hour previously recorded being 91 miles at Fleetwood in a gale which occurred on May 20, 1887. At Holyhead the wind was 65 miles or above, force 10 of Beaufort's notation, for 31 hours, and was 85 miles an hour or above for 4 hours.

The storm appears to have originated on November 7 to the east of the Florida coast, near the Bahamas, and

BAROMETER AND WIND.

Friday, 17th November.	Saturday, 18th November.
8 a.m.	8 a.m.

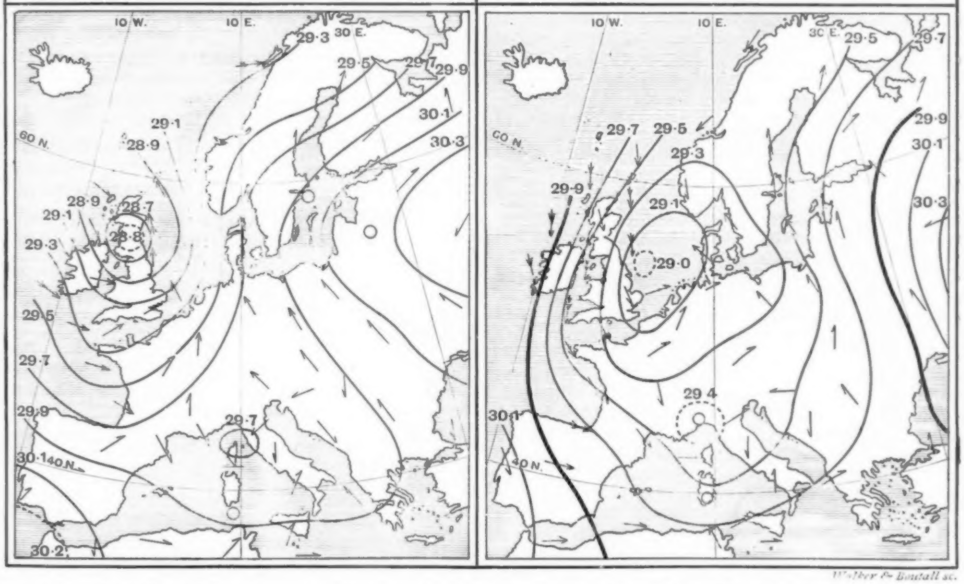

Diagram to illustrate the storm during the period of its greatest violence on November 17 and 18. The barometer is expressed by isobars, the pressure corresponding to each line being given in inches and tenths. The winds are shown by arrows which are drawn flying with the wind. ⊙ = a calm; ⟶ = a light or moderate wind; ⟶ = a fresh or stormy breeze; ⟶ = a gale.

it can be tracked completely across the Atlantic to our islands, and eventually to central Europe on November 20. Several vessels keeping logs for the Meteorological Office, with standard instruments on board, have recorded observations on the storm during its passage across the Atlantic, and the Cunard steamship *Lucania* was under the influence of the disturbance during the whole of her passage from America to England. During the storm no fewer than 335 lives were reported as lost on or near our own coasts, this number being the result of reports received during the four weeks subsequent to the storm.
CHAS. HARDING.

PAUL HENRI FISCHER.

THE Museum of Natural History of Paris has suffered a great loss in the person of Dr. Paul Henri Fischer, the well-known zoologist and palæontologist, who died on November 29, after a long and painful illness. Born at Paris, on July 7, 1835, he received his early classical and medical education at Bordeaux. He became *Interne des Hôpitaux* of Paris in 1859, and obtained his degree of Doctor of Medicine in 1863. The study of medicine did not prevent him from devoting himself also to that of the natural sciences; for in 1861 he entered as Demonstrator in the Laboratory of Palæontology of the Museum of Paris, under the direction of M. d'Archiac. His researches chiefly concerned the living and fossil mollusca, and from 1856 he edited the *Journal de Conchyliologie* in collaboration with M. Crosse. From the position of Demonstrator he rose to be *aide-naturaliste* (assistant), and studied with great success the marine animals of the coasts of France, their geographical and bathymetric distribution. He indicated the depths at which a large number of foraminifera, cœlenterata, echinodemata, mollusca, bryozoa, &c. can be collected on the coasts of the west of France. In collaboration with the Marquis de Folin he undertook the study of the animals dredged in the extremely interesting region of the Gulf of Gascony, to which the name "Fosse du Cap Breton" has been given. The two savants discovered a large number of forms hitherto unknown, and many which recalled species only known in the fossil condition. With M. Delesse he made researches on the submarine sediments of the French shores. He was elected member of the Commission of Dredging, and took part from 1880 to 1883, on board the *Travailleur* and the *Talisman*, in the celebrated expeditions directed by Prof. Milne Edwards. In the course of these expeditions he noted the enormous extension of a cold fauna characterised by boreal and arctic species, and reaching as far as Senegal, where it lives beneath a superficial fauna with intertropical characters. Among the writings of Dr. Fischer, which number not less than 300 titles, including books, pamphlets and memoirs, we may cite: "Paléontologie de l'Asie mineure" (in collaboration with MM. d'Archiac and de Verneuil); "Mollusques de Mexique et de l'Amerique Centrale"; "Species général et iconographie des coquilles vivantes"; "Animaux fossiles du Mont Léberon" (in collaboration with MM. Gaudry and Tournouer); "Paléontologie de l'île de Rhodes"; "Cétacés du Sud-Ouest de la France"; "Catalogue et distribution géographique des mollusques terrestres, fluviatiles et marins d'une partie de l'Indo-Chine; "Sur les caractères de la faune conchyliologique terrestre et fluviatile récemment éteinte du Sahara"; "Sur la faune conchyliologique de l'île d'Haïnan"; numerous memoirs on the malacological fauna of Lord Hudson Island (Pacific Ocean), of Cambodge, of the islands of the Caledonian Archipelago, of Aleutian islands, of the Bay of Suez, &c. In collaboration with M. E. L. Bouvier he published papers on the anatomical peculiarities of certain groups of molluscs. Finally, he wrote a remarkable treatise on conchology which has become classical ("Manuel de Conchyliologie et de paléontologie conchyliologique ou histoire naturelle des mollusques vivants et fossiles, suivi d'un appendice sur les Brachiopodes par Œhlert." In this manual the author showed that the classification of molluscs ought to be based not alone on the form of the shell, but primarily on the anatomical characters.

Dr. Fischer was *Chevalier de la Légion d'Honneur* and *Officier de l'Instruction publique*. He obtained several prizes at the Paris Academy of Sciences, and had been President of the Zoological and Geological Societies of France. He possessed deep erudition, was a charming conversationalist, and after having treated a subject belonging to the domain of the natural sciences or of medicine, he was far from embarrassed if he had to discuss philosophy, literature, or æsthetics. The death of this savant, who was as affable as he was modest, has been a cause for general regret and for deep mourning among his large circle of friends.

EDMOND BORDAGE.

NOTES.

THE Academy of Natural Sciences of Philadelphia has awarded the Hayden Medal to Prof. Huxley. The medal is of bronze, and, with the balance of the interest arising from a sum of 2,500 dollars given to the Academy by the widow of the late Prof. F. V. Hayden, is awarded annually "for the best publication, exploration, discovery, or research in the sciences of geology and palæontology, or in such particular branches thereof as may be designated." The recipient in 1892 was Prof. E. Suess, and in 1891, Prof. E. D. Cope. Prof. J. Hall had the distinction of receiving the first award of the medal in 1890.

SIR HENRY ROSCOE has been appointed to the vacancy in the Senate of London University caused by the death of Sir William Smith.

AN Elliott Cresson Medal has been awarded to Mr. Nikola Tesla, by the Franklin Institute, for his researches in high frequency phenomena.

M. GUYON has been elected a member of the Section de Géographie et Navigation of the Paris Academy of Sciences, in the place of the late Admiral Paris.

DR. E. ZACHARIUS, Extraordinary Professor of Botany in Strasburg University, has been appointed Director of the Hamburg Botanical Gardens.

DR. J. K. HASSKARL, who introduced the cinchona plant into Java, died at Cleves, Germany, on January 5, at the age of eighty-two. In 1852 he was sent by the Dutch Government to South America to collect cinchona seeds and plants. He did not confine himself to collecting *Calisaya*, but gathered seeds and plants of other varieties, some of which were new. In 1854 he successfully carried about four hundred *Calisaya* plants to Java, but two years later he left Java, owing to differences between Dr. Junghuhn and himself on many vital principles of the system of cinchona culture. It is a singular fact, remarks the *Chemist and Druggist*, that the most valuable of all cinchonas, the *Ledgeriana* variety, was not introduced into the Indies by any of the collectors specially appointed by the British or Dutch Governments, but by a private trader in South America, the late Mr. Ledger.

THE annual general meeting of the Geologists' Association will be held at University College, London, on February 2. After the reading of the report and election of officers for the ensuing year, the President will deliver an address on "Geology in the Field and in the Study."

THE twenty-first annual dinner of the old students of the Royal School of Mines will be held on January 29. Among those who have promised to attend are Sir Lowthian Bell, F.R.S., Prof. Roberts Austen, C.B., F.R.S., Prof. Le Neve Foster, F.R.S., Prof. Thorpe, F.R.S., Prof. Rücker, F.R.S., Mr. P. C. Gilchrist, F.R.S., Mr. W. Topley, F.R.S., and other well-known authorities in the mining and metallurgical world.

IF succeeding numbers of the *Psychological Review* are of the same high character as the first, there is little doubt that the journal will meet with the success it deserves. The presidential address, delivered by Prof. Ladd, in December last, before the American Psychological Association, is included in this new *Review*, and several interesting contributions from the Harvard Psychological Laboratory. Among the latter is a paper in which an account is given of an experimental study of memory. The results show that, when isolated, the visual memory surpasses by far the aural, but when combined the aural excels the visual—in other words, in the united action of the senses of sight and hearing, their relative strength is just the reverse of what it is when they act independently. Another contribution from the Harvard Laboratory deals with the intensifying effect of attention. It is usually held that when the attention is directed to an object, the impressions received are intensified. The experiments at Harvard lead, however, to the remarkable result that all stimuli appear relatively less when the attention is from the outset directed to them. In addition to these original papers, the *Review* contains discussions of psychological subjects, and a survey of recent literature upon the subject.

WRITING in the U.S. *Monthly Weather Review*, Mr. Mark W. Harrington remarks that the influences of the wind and tide, and possibly the low barometric pressure of a storm area, in causing an unusual rise of water, is the occasion of much of the damage and loss of life that attends the storms of the Atlantic and Gulf coasts. Observations tending to fix the extent of this high water, and the special causes that produce it are, therefore, always desirable. Mr. Harrington has brought together the records of water, wind, and pressure for two storms, viz. June 4-5, 1891, at Galveston, and October 12-13, 1893, at South Island, Winyah Bay, S.C. The results show that in Winyah Bay, under the influence of winds that were estimated at 90 miles, although doubtless the maximum velocity of the open sea exceeded this, the actual height of the water exceeded that due to the natural tide by 7 or 8 feet. At Galveston, under the influence of easterly winds, whose measured velocity attained 44 miles, the maximum gauge reading was less than 4 feet above the slight natural tide. At these two stations, therefore, the rise in the water surface attributable to the winds is in both cases about twenty times greater than the height of a column of water that can be sustained by such winds in statical equilibrium, as in the Lind anemometer, and this factor is only slightly diminished by making some allowance for the rise of water due to the diminished barometric pressure.

DR. S. C. HEPITES has published, in the *Analele* of the Meteorological Institute of Roumania, a valuable *résumé* of the climate of Sulina from observations taken during fifteen years, 1876-90. The meteorological station is situated on the left bank of the Danube, very near to the sea, and was established by the European Commission of the Danube. The mean annual temperature is 51°·6, the mean difference between the hottest month, July, and the coldest month, January, being 43°·2. The absolute maximum observed was 98°·4, and the minimum −11°·2, which gives an extreme range of 109°·6. The mean relative humidity of the air is 76·5 per cent.; the autumn is damper than the spring. The annual amount of rainfall is only 17·3 inches, on sixty-four days; the wettest month being June, and the dryest, February. The greatest fall in twenty-four hours was 2·59 inches. The prevalent wind is from north-east, the relative frequency from this direction being 20 per cent. Thunderstorms are not of frequent occurrence; they occur mostly in June and July, and not at all in winter. Fog occurs on about twenty-five days in the year; considering the position of the town, we should have expected a more frequent occurrence of this phenomenon. Falls of dust have several times been noted; they apparently come from the Russian Steppes.

MR. J. GLAISHER, F.R.S., contributes to the Quarterly Statement just issued by the Palestine Exploration Fund, a paper on the fall of rain at Jerusalem in the thirty-two years from 1861 to 1892. The average annual rainfall is 25·23 inches, that is, very nearly the same as the mean for London, though the fall is very differently distributed throughout the year. A somewhat remarkable point brought out in the discussion is an evident increase of the fall of rain in the later years of the series of observations. The mean annual fall in the sixteen years from 1861 to 1876 is 22·26 inches, whereas in the sixteen years from 1877 to 1892 the mean is 28·20; therefore the mean annual fall in the second half of the series is 5·94 inches greater than in the first half.

THE honour of being the "oldest fossiliferous rock in Europe" has been claimed for certain strata in Bohemia. Barrande first worked out the Silurian and Cambrian basin in Bohemia, and described a "primordial fauna" at the base of the Cambrian slates near Skrej. Some time later, Prof. Kusta, of Rakonitz, found fossils in the strata below, which had been ranked as pre-Cambrian or Azoic by Barrande. Great interest naturally attached to this discovery of a so-called "ante-primordial fauna," and Prof. Kusta and others wrote several papers upon the fossils. Dr. Jahn, of the Austrian Survey, went for three weeks last summer to the same district, and found that many of the fossils occurred in strata interbedded with the Cambrian series, and had no right to be called "ante-primordial." In a short preliminary note sent to the *Verhandlungen der k. k. geol. Reichsanstalt*, September 30, 1893, he writes that the oldest of the "ante-primordial" horizons of Kusta rests *above* Cambrian shales and interbedded with them, while the so-called "youngest ante-primordial horizon" is in reality the oldest, resting immediately below the Cambrian of Barrande, and containing a similar fauna. As Dr. Jahn's statements rest on good stratigraphical evidence, we can only conclude that the "oldest fossiliferous rocks in Europe" have yet to be found.

THE Geological Commission of the Natural Science Society of Switzerland has just published vol. xxi. part i. of the "Contributions to the Geological Map of Switzerland" ("Beiträge zur Geol. Karte der Schweiz." Bern, 1893.) This part embraces the wide district of the Bernese Oberland Alps. The author, Dr. Edmund von Fellenberg, was always an enthusiastic mountain climber, and between the years 1862-1872 distinguished himself as a pioneer of some of the most difficult ascents in the Bernese group. He was asked, in 1872, by the Geological Commission to make a systematic geological survey of the district, and now gives in this volume of the "Beiträge" the complete result of his scientific labours. The maps which he used in surveying were on the scale of 1 : 50,000; those have been reduced to the scale of the Dufour map, 1 : 100,000. The value of the work is greatly enhanced by an elaborate "Atlas," containing eighteen plates and a map showing the routes undertaken by the author. The plates include an important series of coloured geological sections through the Breithorn, the Aletschhorn, the Jungfrau and the Finsteraarhorn mountains, a great number of sketches from nature illustrating in detail the geological features of the landscape, and several prints from photo-

graphs taken mainly for the purpose of demonstrating the intricate folding of the rocks and the varied effects of weathering in those glaciated Alpine areas. The "Atlas" merits a wider circle of admirers than merely the students of geology, for it reveals in the most effective manner the structure of one of the grandest regions of the Alps, a region which must be familiar to all English lovers of the Swiss lakes, Grindelwald, and the Rhone Valley.

THE *Electrician* of January 19 contains an interesting coloured map showing the electric-lighting districts of London. Our contemporary says that the chief alteration in the map, as compared with the one of last year, is the extension of the city mains. The Chelsea Company has run down the King's Road, but the London Company has followed it, and is in active competition. The Metropolitan Company and St. Pancras Vestry have thrown out a branch or two, but the additions to the mains have, on the whole, been made by "drawing in" additional conductors rather than by advance into new streets. In another place we read that the Owens College Physical Laboratory is prepared to test a limited number of electrical instruments free of charge. The testing will be carried out by qualified assistants, the electrical standards will be compared from time to time with those of the Board of Trade, and every effort will be made to ensure accuracy. All enquiries should be addressed to Prof. Arthur Schuster, Owens College, and headed "Physical Laboratory Testing Department."

THE recently published report of the Magnetic Observatory of Copenhagen for 1892 contains a description of the work which has been carried on in the "field," as well as tables containing the results of the observations made at the observatory. The tables given include the values of the declination, horizontal force, and vertical force for every hour for each day of the year (1892) as obtained from the self-recording instruments, the absolute value of the readings having been determined on five or six days in each month. There are also tables giving the diurnal variations which have been derived from measurements made on selected quiet days. Observations made in the island of Bornholm show that there exists considerable magnetic disturbance, for while if there were no disturbance the declination would vary between 9° 11′ on the east side and 9° 29′ on the west, it is found that at some places on the east shore the declination is 11°, and at one spot near the middle of the west shore values as low as 7° have been obtained. Observations which had been made in 1892 showed that the true lines of equal declination were in many cases closed curves, and thus the disturbances must extend to the surrounding water. With a view to tracing the isogonals after they leave the land, M. Hammer has made a series of declination observations on a raft which had been made without any iron, and a map showing the isogonals obtained is published in the report. The greater part of the island consists of granite containing iron, and a small piece of the rock when brought near the box containing the declination needle is found to give a deflection of from a few minutes to two degrees. A map showing by means of arrows the disturbances in horizontal force, indicates in a very clear and striking manner that there exists a strong centre of force a little to the north of the middle of the island. A special series of observations have enabled the magnetic effect of a number of dykes consisting of diabase to be shown and measured, a full account of which will be published in the *Bulletin de l'Académie Royale de Danemark.*

THE occurrence of true dropsical diseases of plants, not due to the activity of micro-organisms, has been placed beyond doubt by Mr. G. F. Atkinson, of Cornell University. Such a disease was noticed, as we read in a paper on the subject contributed to *Science*, in some tomatoes grown in the forcing-houses of the University. The leaves were strongly curled, and the veins on the under side were swollen and whitened. The cells in the affected areas were stretched radially to an enormous extent. Finally they burst, giving out a large quantity of water, and leaving elongated, depressed, and blackened areas in various stages of decomposition. Inoculations of healthy plants with cultures from the diseased areas gave no result, and no fungi of ordinary dimensions could be discovered microscopically in the early stages of the trouble. The disease was purely physiological, and due to the preponderance of root-pressure over transpiration in the moist and warm atmosphere of the forcing-house, the leaves not being able to give out the moisture absorbed by the roots. The disease could be brought on artificially by subjecting healthy plants to pressure. Apple trees subjected to severe pruning during the winter suffered from a similar disease when growth began in the spring.

THE second part of vol. i. of "Contributions from the Botanical Laboratory of the University of Pennsylvania" is entirely occupied by a paper by Dr. J. W. Harshberger, entitled "Maize: a botanical and economic study." After a description of the anatomical and histological characters of *Zea Mays*, its origin is discussed at length, and this is followed by a treatise on its geographical distribution, and on its agriculture and economic value. The evidence appears to point, beyond a doubt, to the original home of the maize being Central Mexico, and not Asia, as some have supposed.

THE difficulty of satisfactorily differentiating between the typhoid bacillus and its constant companion the *B. coli communis* still remains, although numerous devices have from time to time been introduced, which have materially assisted in the separate diagnosis of these two bacilli. One of the most recent is that lately described by Dr. Schild (*Centralblatt f. Bakteriologie*, vol. xiv. p. 717), and is based upon the greater sensitiveness exhibited by the typhoid bacillus over the colon bacillus to the action of formalin vapour. Thus, whilst well-developed gelatine-cultures of the typhoid bacillus were destroyed when exposed for seventy-five minutes to the vapour derived from 5 c.c. of formalin, the *B. coli communis* was usually still alive after being similarly treated for two hours. The difference in this respect between these two organisms was still more strikingly brought out in their behaviour in broth to which formalin had been added, the typhoid bacillus being unable to grow in the presence of 1 : 15,000 parts of formalin, whilst the colon bacillus developed vigorously in broth containing 1 : 3000 parts. In order to turn this characteristic to practical account in the separate identification of the typhoid bacillus, Dr. Schild recommends that test-tubes containing 7 c.c. of sterile neutral broth should each receive 0·1 c.c of a 1 per cent. solution of formalin, so that the formalin is present in the proportion of 1 : 7000; the inoculations are then made, and the tubes kept at 37° C. If typhoid bacilli are present, the solutions remain quite clear; but if the colon bacillus has been introduced, turbidity is apparent in twenty-four hours. By this method Dr. Schild states that he was able to separately identify the typhoid and colon bacilli in a sample of well water sent to him from a place where an epidemic of typhoid fever was prevailing.

A LARGE portion of the *Bulletin* of the Royal Gardens, Kew, Nos. 82 and 83, is occupied by an interesting report from Dr. King, of Calcutta, of a botanical exploration of the Sikkim-Tibet frontier, undertaken by Mr. G. A. Gammie. Other papers are on "Poling in Agave Plants," "Coffee Cultivation in the New World," and "The Resources of British Honduras."

A CATALOGUE has been issued showing the works on natural history, mathematical, and physical sciences, offered for sale by Mr. Bernard Quaritch.

THE number of the *Victorian Naturalist* for December, 1893, affords evidence of the activity of the study of various branches of natural history in that colony.

WE have received a paper, reprinted from the *Canadian Record of Science*, October, 1893, in which Mr. J. F. Whiteaves gives descriptions of two new species of ammonites from the Cretaceous rocks of the Queen Charlotte Islands.

DR. J. BERGBOHM has sent us a pamphlet entitled "Entwurf einer neuen Integral-rechnung," Heft ii., in which he develops a new method for the calculation of integrals, and deals with irrationals, exponentials, logarithmic and cyclometric integrals, using his system.

MESSRS. C. GRIFFIN AND CO. have published a "Pocket-Book of Marine Engineering Rules and Tables," for the use of all engaged in the design and construction of marine machinery, naval and mercantile. The authors of the book are Mr. A. E. Seaton and Mr. H. M. Rounthwaite.

To those who purpose a tour in the Bernese Oberland, we can specially recommend a series of papers published in the recent numbers (211-214) of *Europäische Wanderbilder* (Zürich, 1893.) They are written by F. Ebersold, and give a general sketch of the country, as well as information about the new mountain-railways.

Bulletin No. 46 of the U.S. National Museum contains the collected writings, both published and unpublished, of the late Mr. C. H. Bollman, on the Myriapoda of North America. The papers have been edited by Prof. L. M. Underwood, who has added some notes and an introductory review of the literature of the North American Myriapods.

WE are pleased to see that the *Yorkshire Weekly Post* is now publishing weekly a well-written and accurate article dealing with the different branches of natural history, and in which the subject of ornithology and entomology in relation to agriculture is dealt with in a practical manner; miscellaneous science notes are also included, and their sources properly acknowledged.

THE "School Calendar and Handbook of Examinations and Open Scholarships," published by Messrs. Whittaker and Co., is now in its eighth year of issue. The book contains a mass of information concerning the conditions of entrance scholarships and fees in all our Public Schools, Universities, and educational institutions, and is invaluable to the schoolmaster and teacher.

A SECOND edition, revised and enlarged, has been issued of the Guide to Museum No. III. of Economic Botany at the Royal Gardens, Kew. The collection in this museum chiefly consists of specimens of timber, arranged in groups according to the countries producing them. The Guide contains much useful information with regard to the scientific character and economic value of the specimens.

MESSRS. MACMILLAN AND CO. hope to publish in a few days "The Theory of Heat," by Mr. Thomas Preston, Professor of Natural Philosophy, University College, Dublin. In this volume the science of heat is treated in a comprehensive manner, both in its experimental and theoretical aspects. The whole subject has been kept in view rather than the requirements of a particular examination, and the method of exposition is such that the general reader will be interested as well as the specialist.

THE number of *Annuario publicado pelo Observatorio do Rio de Janeiro*, which we have recently received, is the ninth that has been published, and is for the year 1893. In addition to various ephemerides and astronomical data, the volume contains some useful metereological tables with data relating to the climatology and physics of the globe, tables for calculating altitudes from barometric observations, vapour tension, and several others for the use of physicists and those engaged in chemistry. The fifth and concluding part gives the latitude and longtitude of the chief places in Brazil, with the heights in metres of the chief cities above the sea-level, terminating with a brief sketch of the climate of Brazil in general. The tables seem all to have been carefully constructed and brought up to date.

"A HISTORY OF SCANDINAVIAN FISHES," by B. Fries, C. U. Ekström, and C. Sundevall, with coloured plates by W. von Wright, made its first appearance in 1836, and though it was issued in an incomplete form, it gained a wide reputation. As several unpublished paintings by v. Wright were preserved in the archives of the Royal Swedish Academy of Science, and the text of the work could be brought up to date with comparatively slight alterations, Messrs. Sampson Low, Marston, and Co. have decided to issue a new edition. The work of revision and enlargement has been entrusted to Prof. F. A. Smitt, the present occupier of Sundevall's post at the Royal Zoological Museum. The former edition contained descriptions and figures of 64 species; the new one will comprise about 220 Scandinavian species, besides several forms from neighbouring parts, and of special interest to the Scandinavian faunist. Thus the great majority of the fishes of Europe as well as of the Arctic piscine species will be represented in the work, and the new edition will be about four times as comprehensive as the former one.

THE interesting di-nitro derivative of marsh gas, $CH_2(NO_2)_2$, has been isolated in the pure state by Dr. Paul Duden, in the chemical laboratory of the University of Jena. As might be expected, it is a substance of little stability, and many of its metallic derivatives or salts, for the parent substance is endowed with acid properties, are dangerously explosive. The compound itself cannot be preserved, even in sealed tubes, for many hours, becoming converted into gaseous products of decomposition, but its potassium salt, $CHK(NO_2)_2$, is much more stable, and may be kept unchanged for months. The preparation of the acid is best achieved from this potassium salt, by decomposing it at a low temperature with dilute sulphuric acid. The potassium salt may be readily obtained by reducing the di-bromine derivative of dinitromethane by means of an alkaline solution of arsenious oxide. The di-bromine derivative is a substance obtained by distilling tribromaniline with nitric acid. It is added in small portions at a time to the strongly-cooled aqueous solution of the alkaline arsenite, in order to mitigate the violence of the reaction. After the completion of the change the potassium salt is deposited in small bright yellow crystals, which by recrystallisation from hot water yield the salt in perfectly pure large monoclinic prisms. The aqueous solution of these crystals is neutral to litmus, the strong acid being neutralised by the introduction of one atom of potassium. At a temperature near 205° the crystals detonate loudly, evolving a mixture of nitrogen, nitric oxide, and carbon dioxide. Concentrated acids violently decompose the crystals with evolution of red nitrous fumes, but if they are suspended in iced water, and a layer of ether is spread over the surface, they are quietly acted upon by dilute sulphuric acid with liberation of free dinitromethane, as above mentioned. The latter substance is dissolved by the ether, and the dried ethereal solution yields it after evaporation of the ether as a yellowish liquid of peculiar acid odour, and which soon begins to effervesce, owing to the elimination of products of decomposition. The free compound may be preserved much longer in ethereal or benzene solution. The silver salt, $CHAg(NO_2)_2$, is the most remarkable of its salts. It crystallises in bright green tabular crystals, which are extremely sensitive to light. Mere boiling of their aqueous solution is sufficient to produce deposition of metallic silver. Either upon warming or by contact with a drop of hydrochloric acid, the crystals explode with great violence. Upon reduction of the iced solution of the potassium salt by sodium amalgam, a curious

substance of the composition CH_2N_2O is produced, which explodes below the temperature of boiling water. An account of the work is contributed to the current *Berichte*.

A NEW mode of preparing methylamine and ethylamine, based upon the reduction of the remarkable ammoniacal compounds of formaldehyde and acetaldehyde, is described by MM. Trillat and Fayollat in the current issue of the *Bulletin de la Société Chimique*. When aqueous solutions of formaldehyde and ammonia are mixed, a vigorous reaction occurs with considerable rise of temperature, and the evaporated liquid deposits hexagonal needles of the ammoniacal compound, the composition of which has been given by several chemists as $N_4(CH_2)_6$. It is now shown that the reaction can be much more simply explained in the light of the behaviour of the compound upon reduction, by accepting the simpler formula $N_2(CH_2)_3$. By the direct union of equal molecules of formaldehyde and ammonia, the substance $CH_2 : NH$, methylene imide, is supposed to be produced, two molecules of which then combine with another molecule of formaldehyde to produce the compound in question $CH_2\left\langle\begin{matrix} N : CH_2 \\ N : CH_2 \end{matrix}\right.$ with elimination of a molecule of water. This substance is rapidly broken up upon treatment with zinc dust and hydrochloric acid, and subsequent addition of caustic alkali, with liberation of methylamine. It is probable that four atoms of hydrogen are taken up during the reduction, thus fully saturating the molecule and forming the compound $CH_2\left\langle\begin{matrix} NH \cdot CH_3 \\ NH \cdot CH_3 \end{matrix}\right.$; this latter substance then becomes converted into formaldehyde and methylamine by assimilation of water during the saponification with alkali. In order to prepare methylamine it is unnecessary to isolate the ammoniacal compound; formaldehyde and ammonia are simply mixed and immediately treated with zinc dust and dilute hydrochloric acid. The liquid is then saturated with caustic alkali, and the methylamine, together with excess of ammonia, expelled by a current of steam and received in dilute hydrochloric acid. Upon evaporation of the acid solution, a mixture of sal-ammoniac and methylamine hydrochloride is left, and the latter may readily be extracted by absolute alcohol. A second distillation of the methylamine hydrochloride with caustic alkali yields pure methylamine. Ethylamine may be similarly prepared by reduction and saponification of the well-known compound of acetaldehyde and ammonia.

THE additions to the Zoological Society's Gardens during the past week include a Himalayan Monkey (*Macacus assamensis*, ♀) from Sikhim, presented by Capt. Edmund A. Grubbe; a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by the Rev. Thomas Rickards; two Japanese Pheasants (*Phasianus versicolor*, ♂ ♀) from Japan, presented by Mr. W. Rudge Rootes; two Spanish Terrapins (*Clemmys leprosa*) from Melilla, North Africa, presented by Mr. Bennet Burleigh; a Dwarf Chameleon (*Chamæleon pumilus*) from South Africa, presented by Mr. E. Wingate; five Gigantic Salamanders (*Megalabatrachus maximus*) from Japan, deposited; a Cuvier's Podargus (*Podargus cuvieri*) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

REPORT OF THE WOLSINGHAM OBSERVATORY.—The Rev. T. E. Espin is to be congratulated upon the large amount of good work he is carrying on at the Wolsingham Observatory. The system he adopts of sending out circulars announcing any new or strange phenomenon observed by him, is one that could be followed with advantage in many other observatories, for astronomers thus have their attention drawn to interesting objects that they might otherwise have overlooked. We have noted the contents of these circulars from time to time, and the report that has just been issued sums up the work done in 1893. Sweeps for stars with remarkable spectra were made on fifty-three nights during the year. The total number of stars detected was 578, of which 489 were found to be new to Argelander's Chart. A thorough examination was made of the Red Region in Cygnus, and several new objects detected. Many nebulous objects were also met with, fifteen of which are not contained in the New General Catalogue. The Compton 8-inch photographic telescope was used during the year for photographing stars suspected of variation. The variability of four stars was confirmed, and three new variables were detected. Mr. Espin points out that it is much to be desired that the Compton instrument should be mounted separately, so that the large telescope could be devoted exclusively to spectroscopic work. During the latter part of the year photographic work was almost entirely discontinued, on account of the necessity of using the large telescope for spectroscopic observations. Early in last year the Observatory sustained a severe loss in the sudden death of Miss Brook, who equipped the Observatory with meteorological instruments, and generously defrayed all the incidental expenses. We hope a new benefactor will soon spring up and supply the much-needed mounting for the photographic telescope.

ANOMALOUS APPEARANCE OF JUPITER'S FIRST SATELLITE.—It will be remembered that in September 1890, Profs. Burnham and Barnard saw the first satellite of Jupiter, with the 12-inch telescope of the Lick Observatory, crossing the disc of the planet as a small dark double spot like a close double star (*Astr. Nach.* No. 2995). Various suggestions were made to account for this anamalous appearance, and it was even supposed for a time that the satellite was actually duplex. The explanation that found greatest favour in the eyes of astronomers, however, was that there was a permanent bright belt around the satellite, approximately parallel to Jupiter's belts, while the poles of this "Galilean star" are of a dusky hue. A repetition of the phenomenon was observed by Prof. Barnard, on September 25 of last year, with the 36-inch Lick telescope (*Astr. Nach.* No. 3206). The observations show that beyond doubt the second explanation is the true one. The satellite apparently rotates on an axis nearly perpendicular to the plane of its orbit. When it is over a portion of the Jovian disc as dark as its own polar regions, it appears more or less elongated, and parallel to the belts of Jupiter. But when it is projected on a brighter region it appears double, with the components in a line nearly vertical to Jupiter's equator, the dusky polar regions alone being visible. The smaller size of the southern component is very probably a perspective effect produced by a tilt towards Jupiter of the satellite's south pole.

ASTRONOMY AND ASTRO-PHYSICS.—The January number of *Astronomy and Astro-Physics* maintains the high reputation of that journal. Prof. W. H. Pickering describes a number of different telescope mountings in use in England and France, and compares them with some of those employed on the other side of the Atlantic. The history and work of the National Argentine Observatory forms the subject of a paper by Mr. J. M. Thorne, the director. The immense number of observations made in that Observatory testifies to the zeal of the astronomers as well as to the generally cloudless sky of Cordoba. Prof. S. W. Burnham gives a descriptive list of so-called double stars, of which the change of position is the result of proper motion. An important paper is contributed by Prof. F. H. Bigelow on the polar radiation from the sun, and its influence in forming the high and low atmospheric pressures of the United States. Prof. E. C. Pickering gives a brief account of the new star that appeared in the constellation Norma last summer, and was discovered by Mrs. Fleming on October 26, while examining a photograph of the spectra of the stars in its vicinity. An excellent plate accompanies the account, showing that the spectra of Nova Aurigæ and Nova Normæ were exactly alike, line for line. Among other articles of interest is one on Prof. Langley's recent progress in bolometer work at the Smithsonian Astro-Physical Observatory, and another on the object-glass grating, by Mr. L. E. Jewell. In the latter paper it is proposed to construct a photographic object-glass grating for use instead of the object-glass prism in obtaining photographs of stellar spectra. The plan suggested is to photograph a series of images of a long narrow slit. This

can be done by having a slit and photographic lens fixed and placing the sensitised plate upon the carriage of a dividing engine. The plate is moved along with the carriage, and when it has been exposed to the slit a desired number of times it is developed and fixed, the result being a photographic grating.

GEOGRAPHICAL NOTES.

A TELEGRAM from Zanzibar, dated January 16, states that over a hundred deserters from Mr. Astor Chanler's expedition had reached the coast and reported that he was left with only eighteen men at Daicho. It has already been mentioned (NATURE, vol. xlix. p. 112) that the expedition was deprived of Lieutenant von Höhnel's services, by an accident. We trust that Mr. Chanler may be able to reorganise his expedition, and push into the unknown country on the borders of which he has been so long detained.

THE *Times* correspondent at St. Petersburg states that Mr. F. G. Jackson, after testing his sledges and other appliances in the neighbourhood of the Yugor Strait, is returning to England *via* Lapland, and that he has not been in the Yalmal peninsula. The proposed North Polar expedition *via* Franz Josef Land, will be, if it starts, as is expected, this year, the fourth in the field. The others are the private American expedition under Mr. Peary, working from the north of Greenland; the private Norwegian expedition of Mr. Ekroll, which left the north coast of Spitzbergen in summer, relying on a new convertible sledge-boat; and Dr. Nansen's expedition, drifting northward from the neighbourhood of the New Siberian Islands.

THE death is announced, on January 20, of General Sir C. P. Beauchamp Walker, the Foreign Secretary of the Royal Geographical Society.

THE memory of Prince Henry the Navigator, to whose persistent efforts the modern revival of oceanic exploration was mainly due, is to be honoured by the celebration of the 500th anniversary of his birth, in March, with great festivities at Oporto. The proceedings will to a certain extent resemble the Columbus celebration recently held in Spain. The event they are to commemorate was even more important, since the Portuguese explorers, as a direct consequence of the encouragement of the half-English prince, discovered the ocean-road to India, and incidentally the coast of South America also, independently of the Spanish voyagers who followed in Columbus' track.

SEVERAL recent experiments on oceanic currents by means of floats have been noticed in the newspapers within the last fortnight. Mr. J. E. Muddock states in the *Times* that a corked soda-water bottle containing an addressed slip of paper which was thrown overboard by him off the entrance to the Strait of Belleisle, on July 12, 1892, was picked up on November 28, 1893, on the Norwegian coast near Kvarno, in latitude 61° 4' N. The bottle was launched farther north than any of those placed in the water by the Prince of Monaco, but there is no clue to its course beyond that of the time elapsing before it was found, 485 days. Mr. Muddock assumes that the drift was 4000 miles, but the direct distance by sea is only 2500 miles, although it is probable that the bottle drifted south in the Labrador current before turning north-eastward with the Gulf Stream. Mr. Ballingall, of Largo, writes to the *Scotsman* that he launched a cork-covered bottle at Largo, on the Firth of Forth, on November 22, which was picked up at Akre, on the Norwegian coast (lat. 59° 19'), 460 miles distant, on December 29. Being only thirty-seven days in the water, the bottle must have drifted at the rate of not less than twelve miles a day. The bottle probably floated high and was helped by westerly winds; but in any case the rate of movement is rapid, and if the direction of the current was that usually assumed, first southward, then east, and finally north, the velocity is very remarkable.

EARTH MOVEMENTS.

EVERY year, every day, and possibly every hour, the physicist and observer of nature discovers something which attracts attention, causes wonder, and affords material for discussion At one moment we are invited to see solidified air, at another to listen to telephonic messages that are being transmitted without a wire, or to pause with astonishment before a pen which is producing a fac-simile of the writing, the sketches, and the erasures of a person who may be in a distant city. Not a day passes without a new creation or discovery, and novelties for our edification and instruction are brought to our notice at the meetings of societies and conventions which from time to time are held in various parts of the world. At the last meeting of the British Association, held in Nottingham, the attention of members was called to the reports of two committees summarising a series of facts which seem destined to open a new field in the science which treats of movements in the crust of our earth. For thirteen years one of these committees has devoted its attention to the volcanic and seismic phenomena of Japan, with the result that our knowledge of these subjects has been considerably extended. Now we observe that earthquakes, which are referred to as catastrophes in the processes of mountain formation and the elevation or depression along our coast-lines, are spoken of as "vulgar disturbances" which interfere with the observation of certain earth movements which are probably as common to England as they are to Japan.

Earthquake observations, although still capable of yielding much that is new, are for the present relegated to a subordinate position, while the study of a tide-like movement of the surface of our earth, which has been observed in Germany and Japan, earth tremors, and a variety of other movements, which we are assured are continually happening beneath our feet, are to take their place. Only in a few countries do earthquakes occur with sufficient frequency to make them worthy of serious attention. The new movements to which we are introduced are occurring at all times and in all countries, and we are asked to picture our continents as surfaces with a configuration that is always changing. We are told that every twenty-four hours the ground on which we live is gently tilted, so that the buildings in our cities, and the tall chimneys in our manufacturing towns, are slightly inclined like stalks of corn bent over by a steady breeze. The greatest tilting takes place during the night; in the morning all return to the vertical.

Why such a movement should exist, we are not told. All that we hear, is that it is too large for a terrain tide produced by lunar attraction. In Japan it appears possible that it may prove to be a concertina-like opening and shutting of the crumpled strata forming a range of mountains. To determine whether this intermittent puckering of strata, which would mean a daily increase and decrease in the height of mountains, explains the variability in the level of districts where observations have been made, is a matter for future investigation.

A problem which suggests itself in connection with this novel work will be to determine the limiting change in inclination, which we will assume means rock-bending, that culminates in sudden fracture and a jar, causing an earthquake.

Earthquake prophets up to the present appear to have lived upon the reputation of a few correct guesses, the non-occurrence of which would have been contrary to the laws of chance. As observation has shown us that a very large proportion of our earthquakes, like those which occur in the Himalayas and the Alps, and even those which occur in volcanic Japan, are produced by faulting or sudden breakages in crumpling strata, rather than by explosions at volcanic foci, it would seem that a study of the bending which leads to fracture would be a legitimate method to approach the vexed question of earthquake prediction.

Another class of movements to which our attention is called are our old acquaintances, the microseismic or tremor storms, which are now defined as long flat waves which give to the surface of our earth a movement not unlike the swell we so often see upon an ocean. Such disturbances are particularly noticeable whenever a district is crossed by a steep barometrical gradient. It is not unlikely that these movements, which are appreciable at considerable depths, have an effect upon the escape of fire-damp at our collieries, that they may influence the accuracy of delicate weighing operations—as, for example, during the determination of standard weights—that they may interfere with gravitational observations, and that they are a neglected source of error in certain classes of astronomical work. Our attention is next directed to the bending effect produced in certain districts by the rise and fall of the barometer, certain areas under variations in atmospheric pressure behaving as if they were the vacuum chambers of an aneroid.

Then there are the earthquakes of comparatively restful countries like our own. A large fault, by which mountains are suddenly lowered and valleys compressed, takes place in a distant country

like Japan. Near the origin of the dislocation the shaking brings down forests from the mountain-sides, and the neighbouring district is devastated. As the waves spread they become less and less violent until, after radiating a few hundred miles, they are no longer appreciable to our senses. But the earthquake has not ended. As long, flat, easy undulations it continues on until it has spread over the whole surface of our globe. The waves passing under Asia and Europe reach England first, while those crossing the meridian of our Antipodes and North America arrive somewhat later. At Potsdam, Wilhelmshaven, and in Japan, waves of this order have often been recorded, but for the rest of the world they are thus far unrecognised. Great cities like London and New York are often rocked gently to and fro; but these world-wide movements, which may be utilised in connection with the determination of physical constants relating to the rigidity of our planet's crust, because they are so gentle, have escaped attention.

That the earth is breathing, that the tall buildings upon its surface are continually being moved to and fro, like the masts of ships upon an ocean, are at present facts which have received but little recognition. Spasmodic movements which ruin cities attract attention for the moment, but when the dead are buried, and the survivors have rebuilt their homes, all is soon forgotten. It seems desirable that more should be done to advance our knowledge of the exact nature of all earth-movements, by establishing seismological observatories, or at least preventing those in existence from sinking to decay.

J. MILNE.

THE CLIMATIC AND NATIONAL-ECONOMIC INFLUENCE OF FORESTS.

IT is to German scientific men that we owe the first steps taken in order to ascertain data concerning the actual climatic effects of forests. Since then, however, most civilised countries, except Britain, have been actively engaged in the collection of accurate data concerning this very important subject. So far as those data have yet been collated and compared they lead to the following results.

It was not until the year 1867 that exact scientific observations were undertaken on an extensive scale to determine the actual influence which forests have in modifying the temperature of the air and of the soil within their own areas and over the surrounding tracts of country, and the first results were published in Ebermayer's celebrated work, *Die physikalischen Einwirkungen des Waldes auf Lufte und Boden*, 1873.

1. *As regards Atmospheric Temperature.*—The average results of observations made during ten years (1876-85) throughout nearly the whole of Germany, and in parts of France and Switzerland, in different kinds of forest, at heights above the sea-level varying from 10 to 3000 feet, and at latitudes varying from $47\frac{1}{2}°$ to $55\frac{1}{2}°$, prove conclusively that in general the annual average temperature within forests growing in closed canopy is lower than in the open, although the crowns of the trees are on the whole a little warmer in winter. The difference is greatest in summer, least in winter, and about midway between these extremes in spring and autumn; the mean annual difference, however, seldom amounts to over 1° Fahr. near the ground, and is scarcely $\frac{1}{2}°$ in the crowns. The prevention of insolation of the soil during the long hot days of summer, and the rapid transpiration taking place through the foliage, exert a greater influence on the atmospheric temperature than can be ascribed to shelter from wind and to decrease of nocturnal radiation.

The observations recorded prove (1) that the variations between the temperatures of the trees themselves and the air in the open exceed those between the woodland air and the latter except during winter, (2) that they are largest during the most active period of vegetation in summer, and (3) that they are greater in spring, when the circulation of sap begins, than during the autumn months, when vitality becomes sluggish and dormant.

In the crown of the trees, where insolation by day and radiation by night make their full influence felt, the difference in the daily average over the whole year is less than it is near the ground. In winter it averages little either above or below 0°, and in summer usually about the half of the reading at 5 ft. above the ground.

Observations made in Southern Germany establish the fact that in the forests it is cooler during the day and warmer during the night than in the open.

During the night the trees interfere with the radiation of heat, and in the day-time the shade afforded by the crowns keeps the air from being rapidly warmed by the sun's rays. These influences are naturally strongest during spring, summer, and autumn, when foliage is most abundant, whilst in winter the coniferous forests with evergreen foliage are milder than deciduous forests.

Owing to these differences in temperature, beneficial currents of air are induced between the forests and the open country, which follow the same law as obtains in regard to land and sea breezes. During the day the cooler and moister air of the forest sets outwards to take the place of the heated air ascending in the open; at night the current sets in from the open, cooled by radiation, towards the forest.

The statistics, upon which these deductions are based, prove that the immediate action of forests is to modify the daily maxima and minima of atmospheric temperature, whence it may be deduced that a comparison of the absolute extremes of temperature during the year must exhibit definitely the sum total of the influence exerted by forests on the temperature of the atmosphere. This modification of the extremes of temperature, which are bad alike for man and beast, and also for agricultural operations, is of immense importance from a national-economic point of view, since many places that were once fertile are now little better than barren wastes in consequence of the reckless denudation of forest.

In registering the data, however, it was observed that the geographical position, and the exposure of the forests to winds, exerted a certain amount of modifying influence in lessening the differences, and there are reasons to believe that towards the crown the forest temperature in winter is considerably higher than down nearer the ground. It was found, too, that certain forest trees exerted greater influence than others in consequence of the density of their foliage; for beech forests in summer exert, through their dense foliage and complete canopy, a considerably greater influence in diminishing the extremes of temperature than forests of spruce or Scots pine, although after defoliation their influence is merely similar to that of the pine forest, and only half so great as that of the more densely foliaged spruce.

2. *As regards Soil-Temperature.*—The influence exerted on the soil temperature by forests growing in close canopy is of considerable importance, especially with regard to the soil-moisture. The observations made concerning this point seem to make it clear that the mean annual temperature of the soil in the forest is at all the above depths of observation cooler than in the open, and that the differences are greatest in summer, about the mean in spring and autumn, and very small in winter. In countries with warm summers this reduction of the soil-temperature over large areas by means of forest growth has a decidedly beneficial result. According to observations made in Würtemberg, the difference between the maxima of soil-temperature in forests and in the open can extend so far as up to 14° Fahr.

It was also found that the daily differences in soil-temperature varied according to the season of the year, but that throughout nearly the whole year the upper layers of soil in the open were warmer in the afternoon than in the forenoon, whereas in the forest the variations were inconsiderable.

As with regard to the atmospheric temperature, the influence of the forest trees in equalising the soil-temperature throughout the year is greatest in the case of trees whose foliage is densest, spruce heading the list.

3. *As regards the Degree of Atmospheric Humidity.*—Observations recorded throughout Central Germany show that *as regards the absolute humidity of the air* forests have no appreciable climatic effect, for the annual averages showed merely slight traces of differences at 5 feet above the soil.

The differences between the relative humidity of the air in forests and in the open are, as might be expected, greatest in summer, although very different results as regard variations are obtained with changes of altitude and of other physical conditions.

The results of the various series of observations, corrected so as to eliminate, so far as possible, local differences due to altitude and other physical dissimilarities in the various meteorological stations, show that the mean annual relative humidity of woodland air is from $3\frac{1}{2}$ to 10 per cent. greater than that of air in the open, but that the difference varies greatly according to the season of the year, being greatest in summer and autumn, and least in winter and spring. They show, too, that large

areas covered with spruce will be moister, as well as cooler, than those under woods of less densely foliaged species of trees. In Bavaria it was found that in summer, in consequence of the density of the foliage in beech forests during the most active period of growth, the difference even amounted to 13·6 per cent. of saturation over the relative humidity in the open.

4. *As regards the Precipitation of Aqueous Vapour.*—It has been shown above, not only that the atmosphere within the forest is cooler than in the open, but also that the temperature of the trees themselves is lower, especially in summer, than the air surrounding them; hence, when a current of air is wafted from the open into the forest, and comes in contact with the cooler trees, its temperature is reduced, and it is brought nearer to the point of saturation, *i.e.* its relative humidity increases. But if this air was already in the open at, or near, the point of saturation, then the effect of the cooling process is that a certain amount of surplus moisture beyond the aqueous vapour that can be held by the air up to a point of saturation at its reduced temperature must be released and precipitated in the form of dew. Woodlands, therefore, act as condensers of atmospheric moisture, and decrease the absolute humidity of the air whilst increasing its relative humidity; and in addition to this, they increase the humidity of the air by transpiration from the leaves, whilst the sap is being rendered available for structural purposes, and the work of assimilation is proceeding.

Endeavours have been made to establish, by means of careful observations, the effect of forests in regard to the precipitation of aqueous vapour in the form of dew or rain, but the results are often of so conflicting a nature that, up till the present, safe deductions cannot be drawn. In order to compare observations made in the forests with those made at the usual meteorological stations in the open, a correction would in each case be necessary to reduce the localities to the same sea-level, as air cools in rising and increases in relative humidity, *i.e.* it approaches the point at which it must precipitate some of the aqueous vapour held by it. Hence rainfall generally increases with the height of a locality above the sea-level, although no direct proportional increase can be proved. It fluctuates with the geographical position and the varying physical conditions of each point of observation, whilst variations in the direction of the moist winds of the locality also militate against the collection of reliable data for comparison with readings made in other localities.

The mean of the readings at 192 points of observation in Germany, corrected as carefully as possible with reference to these causes of difference, do not seem capable of giving any more exact inference than the general statement, that at high altitudes large extents of forest may considerably increase the local rainfall. As regards the quantity of rainfall and snowfall which is intercepted in forests by the leaves, branches, and stems of the trees, the observations made in Switzerland, Prussia, and Bavaria show that nearly one-fourth of all the precipitations of aqueous vapour is intercepted by the forest trees, and is given off again by evaporation, or is gradually conducted down the stems to the soil. In lofty forest-clad regions the mechanical action of the rains on the surface-soil is thus very much modified.

By means of their lower temperature, their greater relative humidity, and the mechanical obstruction they offer to the movements of currents of air, extensive forests act decidedly as condensers of the aqueous vapour contained in the atmosphere, and their influence in this respect is more marked at high altitudes and in mountainous districts than on plains or near the sea-coast, where other physical factors come into competition with and modify it. Further data are still requisite to enable us to determine with anything like certainty that forests directly cause increase of precipitations irrespective of such local considerations as the ruling direction of winds and peculiarities of situation; the generally accepted dictum is, however, that in the vicinity of extensive forests the rainfall is greater than at other localities under otherwise similar physical conditions.

In portions of the Russian Steppes, planted up nearly 50 years ago, the inhabitants assert that the summer rainfall has considerably increased, and that the danger to crops from drought is not so great as formerly, whilst the villages are also protected by the forest from the violence of the winter storms.

In summarising and criticising this point Prof. Endres of Karlsruhe remarks as follows[1]:—

[1] Conrad, Elster, Lexis, and Loening's "Handworterbuch der Staatswissenschaften," 1892, vol. iii. page 608.

"The data furnished from tropical countries must be accepted with the greatest caution, and in any case they afford no conclusive deductions for European circumstances. Blandford reports from India (*Meteorological Journal*, 1888) that in an area of 61,000 square miles, which was formerly denuded of woodlands, but has been planted up again from 1875, the rainfall has increased 12 per cent. since then. But H. Gannet (*Weather*, vol. v.) arrives at exactly the opposite conclusions for America, as his observations in the prairie region and in Ohio go to prove that the re-wooding of a tract exerts no perceptible difference on the amount of the aqueous precipitations. Lendenfeld also tries to prove that the clearance of woodlands in Australia has resulted in a better climate and an increase in rainfall, as the soil under eucalyptus remains hard as stone and inabsorptive, whilst it is rendered lighter and more porous by grass. (*Petermann's Geog. Mittheilungen*, vol xxxiv.)."

5. *As regards Evaporation of Soil-Moisture.*—The low temperature and the high relative humidity of the atmosphere in forests are unfavourable to rapid evaporation, which is still further reduced by the protection afforded to the soil against direct insolation and the action of winds. From observations extending over 10 years (1876-85) in various parts of Germany and Austria, the following relation is shown between evaporation in the forests and in the open in the vicinity of the forests: the differences would probably be greater if comparisons had been made with places in the open that were far removed from the modifying influence of the woodlands:—

	Water evaporated.	
In the open . .	20·9 inches	The practical importance of this will be seen, when it is recollected that the mineral food in the soil can be taken up by the rootlets only in the form of *soluble* salts.
In the forest . .	9·5 ,,	
Lower in forest than in open by .	11·4 inches	
Evaporation in forest expressed in percentage of that in the open .	46 per cent.	

It was also found that the amount of evaporation depended on the class of forest, thus:—

Species of Woodland.	Percentage of Water. Evaporated in the Forest.	Remaining in the Soil.
Beech	40 ...	60
Spruce	45 ...	55
Scots pine	42 ...	58
Clearing for reproduction ...	90 ...	10

In these statistics no account has been taken of the quantity of water given to the air by transpiration through the leaves; but this is not of essential importance, as such supplies of moisture are drawn by trees, except during the earliest stages of growth, from the deeper layers of soil and subsoil not immediately and directly affected by the aqueous precipitations on the surface. This may be less true of spruce than of other trees.

The action of forests, therefore, is to retain in the soil a large proportion of the rainfall or of the moisture arising from the melting of snows, which, by percolation to the lower layers and the subsoil, tends to feed the streams perennially, and to maintain a constant supply of moisture, without which trees could not derive their requisite food-supplies from the soil.

The nature of the soil-covering below the forest trees exerts also considerable influence on the amount of moisture evaporated. From experiments conducted during five years in Bavaria it was found that a good layer of fallen leaves, and of *humus* or vegetable mould formed by their decay, is a powerful factor; it diminishes the evaporation by more than half, or reduces it to less than one quarter of that in the open, and thus adds very considerably to the surplus amount of moisture retained in the soil.

6. *As regards the Feeding of Streams and the Protection of the*

Soil.—From the above data it seems evident that the effect of extensive forests, more especially of those situated at high altitudes, is, by cooling the air and reducing its capacity for retaining aqueous vapour, to increase the precipitations. Whilst these precipitations are taking place the crowns of the trees intercept a large proportion of the total, and by breaking the violence of the rainfall protect the soil from the danger of being washed away during heavy storms. By the decomposition of fallen leaves and twigs a strongly hygroscopic soil-covering is formed, capable of imbibing and retaining moisture with sponge-like capacity. Rapid evaporation of the soil-moisture is counteracted through the protection afforded by the foliage against direct insolation during the day, and by the mechanical hindrance offered to currents of wind. The crown of foliage likewise prevents the soil cooling rapidly at night by radiation. The hotter the summer, the more marked are these beneficial effects of the woodlands.

When, therefore, large tracts of country are denuded of timber, increase of temperature during the days of summer, rapid radiation of soil-warmth by night, diminished precipitations (especially in the spring and summer), and unchecked evaporation of moisture, due to complete insolation of the soil by day and absence of any protection from winds, must be the inevitable consequences. Examples of such actual results can be pointed out in many parts of continental Europe, in Western Asia, and throughout India. In Great Britain and Ireland the effects of the wholesale clearance of woodlands have not been so marked, in consequence of the favourable influences exerted on our climate by the Gulf Stream.

In localities having no protective woodlands heavy rains wash away the surface-soil, torrents and freshets rush down the water-courses with great violence, laden with detritus and discoloured with the soil held in mechanical solution, whilst streams and rivers often overflow their banks in consequence, devastating large areas of low-lying tracts under cultivation. Forests, on the other hand, tend to break the violence of the rainfall, and retain for the time being about one-fourth of the total amount on the foliage and branches; the roots of the trees and of the undergrowth help to bind the soil firmly; the rainfall is retained by the vegetable mould and by the spongy growth usually found on the surface-soil, and thence gradually percolates to the deeper layers, where it is held in reserve, to be finally parted with in being utilised for the feeding of perennial streams having their sources on the wooded slopes.

Thus arose in the Alpine districts of Southern Europe the necessity for maintaining *ban-forests* as a protection against landslips, avalanches, &c., and legal measures were early adopted for safeguarding them in order to protect the lower tracts from erosion of the soil when sodden with rainfall or melted snow.

7. *As regards General Hygienic Effect on the Atmosphere.*—It is well known that on the one hand when large tracts of forest are cleared for cultivation, especially in tropical and subtropical countries, fever and ague are frequently the consequence, and on the other that the planting up of notorious fever districts, such as the Campagna di Roma, the Tuscan marshes, and the Russian Steppes, has decidedly diminished the insalubrity of these localities. But the causes are very probably rather due to the degree of direct insolation of the soil, freely afforded in the one case, and counteracted in the other, than to any hygienic property inherent in tree-growth. In the latter case, too, stagnating surplus of soil-moisture may have been got rid of by transpiration through the foliage, and this would of itself go far towards removing causes of insalubrity, and improving the climate.

It is generally accepted that ozone kills miasma in the air, and purifies it—at any rate impure air contains little or no ozone; the proportion of ozone is therefore usually taken as the measure of atmospheric quality. The belief that the woodland air is, like sea air, very rich in ozone has not yet been satisfactorily proved. Experiments in Bavaria showed that in the forests the percentage of ozone, though greater than that in the vicinity of towns, was slightly less than in the open in the vicinity of forests, and that there was no perceptible difference in this respect between coniferous and deciduous forests.

The woodland air was found to contain most ozone in winter, which shows that its production could not be due to any chemical action of the foliage, for there are no leaves on deciduous trees at that season, whilst conifers transpire merely, and do not assimilate. It also indicates that the excess is probably due to the comparative freedom of air in the forest from the smoke, carbonic acid, and many other impurities with which air in the vicinity of towns is contaminated and defiled, and to the withdrawal of enormous supplies of oxygen from the air which takes place for the support of animal life at all populous centres. Thus whilst in general the quantity of carbonic acid in the atmosphere is somewhat under four volumes in 10,000, that is the normal amount in London air; but in thick fogs this proportion is frequently doubled, and has been known to be more than trebled, or even to exceed 14 volumes in the city.

Sunlight, however, has the power of decomposing carbonic acid in the presence of chlorophyll, the green colouring matter contained in foliage, the carbon being absorbed by the plant for its growth, and the oxygen set free. During darkness a contrary action takes place, oxygen being consumed by the foliage, and carbonic acid given off. As, however, particularly in the case of deciduous trees which are in leaf only from April till October, the hours of light far exceed in number those of darkness, the general hygienic effect of trees in cities and towns—apart from their invaluable æsthetic influence—tends decidedly towards the purification of the atmosphere from excess of carbonic acid.

Ozone again is an allotropic modification of oxygen obtainable by passing a series of electrical discharges through it; hence it is more than probable that in forests in exposed localities, more especially those at high altitudes, where storms and electrical disturbances of the air are most frequent, a greater quantity of ozone must be generated in the atmosphere than in localities less subject to such powerful ozonising influences.

Ebermayer, undoubtedly one of the greatest authorities on this subject, says[1]:—

"In the middle of the great 'ozone-factory,' which we must consider the forest to be, neither more oxygen nor less carbonic acid is offered to mankind for breathing than over large unwooded areas."

At another part of the same article he also adds[2]:—

"From the hygienic standpoint it is worthy of notice that, according to my examinations, the air in and immediately above the crowns, then that in the immediate vicinity of the forests, has more ozone than that in the interior of the forests, where a portion of the ozone is consumed by the decomposing foliage lying on the ground."

It appears, therefore, to be his matured opinion at present that whilst more ozone is found in forests than in the open—which the Austrian students of the subject deny, or at any rate are not yet prepared to admit without further observations and proofs—yet the decomposing matter covering the soil consumes the surplus, and often more than that, so that no difference can be established in favour of the forest air. In this withdrawal of ozone in excessive quantities from the air by decomposing vegetable matter, the unhealthiness of tropical jungles, and the prevalence of malaria at all the lower elevations within the tropics usually covered by woodlands, seem easily explainable.

According to Endres and to Fernow[3] it is claimed that forests tend to resist the spread of epidemics, and to offer a bar to the progress of diseases like cholera and yellow fever.

Regarding the *Sanitary Influence of Forests*, the latter states (*op. cit.* p. 21) as his summary that "(1) the claimed influence of greater purity of the air due to greater oxygen and ozone production does not seem to be significant; (2) the protection against sun and wind, and consequent absence of extreme conditions, may be considered favourable; (3) the soil connections of the forest are unfavourable to the production and existence of pathogenic microbes, especially those of the cholera and yellow fever, and the comparative absence of wind and dust, in which such microbes are carried in the air, may be considered as the principal claim for the hygienic significance of the forest."

Fortunately there are not many infectious diseases the germs of which can be carried by water; as yet only two are known with certainty, cholera and enteric fever. When outbreaks of these diseases occur in tropical countries, the infectious power of the germs is favoured by warmth and moisture; moreover, when epidemic, these diseases usually break out in thickly populated towns and similar localities, where it is impossible to submit

[1] "Hygienische Bedeutung der Waldluft und des Waldbodens" in vol. xiii. of "Forschungen auf dem Gebiete der Agricultur-Physik," edited by Prof. Wollny, 1890, p. 429.

[2] *Op. cit.*, p. 435.

[3] "Forest Influences," p. 172, 1893.

the soil-moisture or the water-supply to the filtrating action of belts of woodland.

8. *As regards the Agricultural Productive Capacity of Neighbouring Tracts, and the National-Economic Effect on the Soil generally.*—From an agricultural standpoint, a dry season is much preferable to a low temperature and excessive rainfall. In the former case the crops, although they may be somewhat scanty, are invariably of superior quality. A wet season may produce abundant crops, but they are generally of low quality.

With regard to the influence of forests on the aqueous precipitations throughout central Europe, Prof. Endres makes the following remarks[1]:—

"The question whether woodlands can influence the rainfall is one of the most important from a national-economic point of view. Even if this could be distinctly affirmed, the beneficial action of forests would only be established in the rarest cases, for throughout central Europe at present the number of too wet years exceeds that of dry years. *In districts where the rainfall is over 40 inches, any increase is undesirable.*[2] For agriculture very dry years are on the whole less disastrous than extremely wet years. The precipitations of any district are influenced mainly by the position of the mountain ranges with reference to the cardinal points of the compass, by its elevation above sea-level, and its distance from the sea."

But, as the American investigations prove (*idem.* p. 13), "no influence upon the general climate which depends upon cosmic causes can in reason be expected from a forest cover. Only local modifications of climatic conditions may be anticipated, but these modifications, if they exist, are of great practical value, for upon them rest success or failure in agricultural pursuits, and comfort or discomfort of life, within the given cosmic climate. The same condition must be insisted upon with reference to forest influences upon waterflow, which can exist only as local modifications of water conditions, which are due in the first place to climatic, geologic, and topographic conditions."

Even so early as in Roman times it was recognised that too great a clearance of woodland areas brought undesirable changes in the physical conditions of Italy, and affected the welfare of the inhabitants. That the destruction of the ancient forests throughout Great Britain and Ireland, to such an extent that only 3·8 per cent of the total area can now be classified as woodlands (*vide* Parliamentary Report on "Forestry," dated August 5, 1887), was not followed by such disastrous climatic changes as were occasioned by similar causes throughout the Landes, Syria, Asia Minor, Greece, Russia, and many parts of India, we owe entirely to our insular position with its moist climate, and to the happy effects wrought by that portion of the Gulf Stream which reaches our western and southern shores.

Early in the present century, for example, the Agricultural Society of Marseilles reported that in consequence of the reckless destruction of the forests after the revolution of 1789:—

"The winters are colder, the summers hotter, and the beneficial spring and autumn showers no longer fall; the Uveaune, flowing from east to west, rushes down in flood with the least rain, carrying away its banks and flooding the richest pasturage, while, for nine months of the year, its bed lies dry owing to the drying-up of the streams."

To a similar cause also Prof. Geffcken (in *The Speaker* of January 6, 1893) attributes the Russian famine of 1892 in the following terms:—

"We speak of the deficit (in the Russian Budget) of 1893 as certain, and it is easy to show that it will be so. *The principal cause of the present dearth is the drought during the last spring and early summer, and this absence of rain is greatly due to the devastation of the forests.* The area formerly covered with timber was enormous, the woods belonging to the Crown, to the great landed proprietors, and to the village communities. But the means of transport were then so imperfect and costly that only in the neighbourhood of large rivers did the felling of timber pay. This changed with the construction of railways and the abolition of serfdom; the former gave the possibility of selling with profit, and the peasants abandoned their woods to speculators for what they thought a good price, little thinking of the future; the larger proprietors followed their example; the purchase money was spent in drink and luxurious living, and no one thought of replanting. *Too late has the Government issued a law for the protection of forests. Such a devastation going on for 20 years not only exhausts a source of wealth, but has also other bad consequences.* When the country is deprived of its trees, the earth is dried up and crumbles from the hills; the water coming down from heaven cannot be kept back as is the case with the woods, which act as a sponge, but rushes in torrents into the rivers and disappears in the sea, and the consequence is a gradual diminution of the fertility of the soil and the disappearing of numerous brooklets and small rivers, to help the larger ones show a low water-mark, which proves prejudicial to the navigation."

This view is confirmed by the special correspondent of the *Times* (*vide* article "Through Famine-stricken Russia" in issue of April 18, 1892), who writes:—

"I have now travelled over most of the famine-stricken provinces, and I have been struck by the sameness of the picture. Everywhere reckless extravagance meets the eye, the forests have been cut away wantonly, the rivers are neglected, the climate is ruined."

Such also appears to have been the opinion of Major Law, Commercial Attaché to the British Embassy at St. Petersburg, as expressed in his "Report on Agriculture in the South-Eastern Provinces of European Russia," commented on in a leading article of the *Times* of September 17, 1892, in the following words:—

"It is said that this gigantic natural tillage farm (*i.e.* the 'black-soil' region) was formerly hedged in by belts of forest, which served the twofold purpose of sheltering it from the desert winds and of increasing the humidity of the climate. It is certain that these forests do not now exist, and that the black-soil country is often scourged by devastating blasts from the steppe, and not infrequently baked by prolonged droughts. The desert winds pile the snow in drifts into winter, which become the source of destructive torrents in the spring. In summer the same winds are so fierce and arid that in the space of a few hours they wither the corn as it stands, while, when they are laden with sands, they smite the soil itself with perpetual barrenness."

All writers, indeed, who have recently published views on this subject, seem agreed as to the main causes of the recent Russian famine.[1]

In order to obtain the full national-economic benefits that are derivable from woodlands, the areas reserved as forests or planted up should be scattered over the face of the country as equally as possible. In all countries where the population is thin, and primeval forest is still to be found, measures with this end in view can easily be carried out without inflicting any apparent hardship on the existing community. But wherever danger from famine is apt to recur from time to time, it would at the same time seem to be worthy of consideration whether it would not be wise to expropriate tracts of the poorer and higher land here and there, and plant them up on a well-considered scheme for the purpose of ameliorating the climatic conditions for man and beast in the future.

J. NISBET.

1 "Hygienische Bedeutung der Waldluft und des Waldbodens" in vol. xiii. of "Forschungen auf dem Gebiete der Agricultur-Physik," edited by Prof. Wollny, 1890. p. 607.

2 This is a point of very great importance with reference to the proposals of Mr. Munro Ferguson, M.P. (*Contemporary Review* for October 1892, pp. 521, 522), for planting up the Highlands of Scotland, and Dr. Macgregor's three questions in the House on the same subject on November 13, December 12, and December 19, 1893. For if there be already any tendency towards more rainfall during the summer months than is good for agricultural crops, an extensive increase in the acreage of woodlands in such vicinities is not desirable.

1 See also the article on "The Penury of Russia" in the *Edinburgh Review* for January 1893 (pp. 17-19), which may be said to contain a summary of the best opinions on the matter.

SCIENTIFIC SERIALS.

American Journal of Science, January.—Researches in acoustics, No. 9, by Alfred M. Mayer. This paper deals with the law connecting the pitch of a sound with the duration of its residual sensation, and with the smallest consonant intervals among simple tones. The residual sound, *i.e.* the sound perceived by the ear after the actual vibration has ceased, was investigated by means of an apparatus consisting of a tuning-fork vibrating close to the opening of a resonator. The nipple of the resonator was placed opposite a hearing-tube leading to the ear, and the sound was interrupted by a rotating perforated disc interposed between the nipple and the opening of the tube. The discs, which were made of mahogany covered with cardboard, had several circles of holes, and intercepted the sound very

effectively. The discs were worked by a hand-pulley and fly-wheel, controlled by a clock beating seconds loudly. The residual sensations obtained, by noticing at what speed the sound became continuous, ranged from 0·0231 secs. in the case of Ut_2, frequency 128, to 0·0049 secs. in the case of Ut_5, frequency 1024. The smallest consonant intervals were determined by noticing when the beats coalesced into a smooth tone. The residual sensations deduced from these experiments were found to be about one-third greater than those obtained by the former method.—Petroleum in its relations to asphaltic pavement, by S. F. Peckham. While it has been well known for years that bitumens occur in great variety, the selection of a proper material for softening the asphalt, to the exclusion of others less desirable or wholly unfit, appears to have escaped attention. A properly selected material should enter into chemical union with both the constituents of the bitumen in the asphalt, thereby increasing its adhesive and binding properties upon the other constituents of the mastic. The proportion of bitumen to sand and other non-bituminous ingredients should be as 1 : 9, a larger amount of bitumen making the pavement too soft, and a smaller amount giving too little stability.—The age of the extra-moraine fringe in Eastern Pennsylvania, by E. H. Williams, Junr. All observations tend to the conclusion that there was but one ice age in Pennsylvania, and that a short and recent one.—The internal work of the wind, by S. P. Langley (see Notes).—Post-glacial æolian action in Southern New England, by J. B. Woodworth. This paper treats mainly of the action of blown sand in carving rocks and boulders.

In the *Botanical Gazette* for November, 1893, we find a paper on the Food of green plants, by Mr. C. R. Barnes, in which he proposes the term *photo-syntax* for the process of formation of complex carbon compounds out of simple ones under the influence of light.—Mr. H. L. Russell continues his account of the Bacterial flora of the Atlantic Ocean in the vicinity of Woods Holl, Massachusetts; and Miss F. D. Bergen, her useful Record of popular American plant names.

THE third and concluding part of vol. vi. of Cohn's *Beiträge zur Biologie der Pflanzen* contains three important papers.—Dr. M. Scholtz describes the changes in position which take place in the flower-stalk of *Cobæa scandens* before and after flowering. It affords the first recorded instance of an organ with complicated anisotropy. During the development of the bud the flower-stalk exhibits strong negative geotropism and positive heliotropism. After the opening of the flower, which is strongly proterandrous, changes take place in the position of the stamens and style which bring the stigma nearly into the position previously occupied by the anthers.—Herr G. Karsten gives further details of the embryology of *Gnetum*; the development of the male, of the imperfect female, and of the perfect female flowers being described in detail. In the perfect female flowers there are always at first several embryo-sacs; and in some species two or three of these remain till the period of fertilisation, and are capable of impregnation. The actual process of impregnation presents some analogy, on the one hand, to that in the Coniferæ, on the other hand to that in the Casuarineæ. The generative nucleus of the pollen-grain divides within the pollen-tube, as in the Coniferæ. The two portions of this nucleus enter the embryo-sac and coalesce with one of its nuclei. In some species secondary embryos are produced.—R. Hegler gives details of experiments on the influence of mechanical traction on the growth of plants.

Bulletins de la Société d'Anthropologie de Paris, Tome iv. (4e Série), No. 10.—The greater part of this number of the *Bulletins* is occupied by the replies of M. J. M. van Baarda to the questions of the Anthropological Society with regard to the island of Halmaheira, or Gilolo, in the Moluccas. M. G. de Mortillet contributes some palæographical notes on the lower valley of the Seine; and MM. E. Fournier and C. Rivière describe the discovery of objects of the Robenhausian period in the Grotto Loubière, near Marseilles.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 18.—"On the Transformation of Optical Wave-Surfaces by Homogeneous Strain." By Oliver Heaviside, F.R.S.

"On the Reflection and Refraction of Light." By G. A. Schott, formerly Scholar of Trinity College, Cambridge.

Chemical Society, December 21, 1893.—Dr. Armstrong, President, in the chair.—The following papers were read:—Corydaline. Part iii.: Oxidation with potassium permanganate, by J. J. Dobbie and A. Lauder. The authors have investigated corydalinic acid, $C_{11}H_5N(OMe)_4(COOH)_4$, obtained by oxidising corydaline with potassium permanganate.—The properties of α-benzaldoxime and some of its derivatives, by W. R. Dunstan and C. M. Luxmore. Both α-benzaldoxime and its acetyl-derivative may be obtained in the solid state by cooling. The authors are at present examining a number of addition products of the former substance with the halogen acids.—The interaction of acid chlorides and nitrates, by H. E. Armstrong and A. Lapworth.—The freezing points of triple alloys, by C. T. Heycock and F. H. Neville. The existence of a compound of silver and cadmium of the composition $2AgCd$ seems probable from the results of freezing point determinations of mixtures of these metals in tin, lead, or thallium solution. The behaviour of solutions of silver and cadmium in bismuth points to the formation of the compound $4AgCd$. Aluminium and gold appear to form the compound $AuAl_2$ when dissolved together in molten tin.—Synthesis of pentamethylenecarboxylic acid, hexamethylenecarboxylic acid, hexhydrobenzoic acid, and azelaic acid, by E. Haworth and W. H. Perkin, jun. The authors have prepared the acids mentioned above from the products of interaction of a mixture of tetra- and penta-methylene bromides and ethylic sodiomalonate.—The conversion of ortho- into para- and of para- into ortho-quinone derivatives: I. The condensation of aldehydes with β-hydroxy-α-naphthylamine, by S. C. Hooker and W. C. Carnell.—The synthesis of lapachol, by S. C. Hooker. An isomeride of lapachol is obtained by heating an acetic acid solution of hydroxynaphthaquinone with valeric aldehyde and hydrochloric acid.

Geological Society, January 10.—W. H. Hudleston, F.R.S., President, in the chair.—The following communications were read:—On the Rhætic and some Liassic Ostracoda of Britain, by Prof. T. Rupert Jones, F.R.S. The published observations on the occurrence of these Microzoa in the Rhætic and Lower Liassic strata of England, chiefly in Gloucestershire and Somerset, by the Rev. P. B. Brodie, H. E. Strickland, C. Moore, and others, were given; and the various notices of the so-called *Cypris liassica* in various palæontological works were considered. Numerous specimens submitted by the Rev. P. B. Brodie, the Rev. H. H. Winwood, and Mr. E. Wilson, and some few examined in the Geological Society's collection, have been studied, with the result of determining the characters and alliances of *Darwinula liassica* (Brodie) and of six or seven other species found in the same and the associated series of strata. The *Darwinula globosa* (Duff), from Linksfield, Morayshire, was also critically re-examined as one of this interesting series of Rhætic Ostracoda. The other species belong for the most part to *Cytheridea*; thus most of them probably lived in brackish or estuarine waters. The President and Dr. Henry Woodward spoke on the subject of the paper, and the author replied.—Leigh Creek Jurassic Coal-Measures of South Australia: their origin, composition, physical, and chemical characters; and recent subaërial metamorphism of local superficial drift, by James Parkinson. This paper dealt with the lignitic coal of Leigh Creek and associated rocks. Analyses were given, as illustrating comparisons between the Leigh Creek coal and Jurassic and other coal-bearing rocks found elsewhere. The author discussed the origin of the Leigh Creek deposits, and described certain peculiarities noticeable in the superficial materials. The President and Mr. Browne made a few remarks upon the subject of the paper.—Physical and chemical geology of the interior of Australia: recent subaërial metamorphism of Eolian sand at ordinary atmospheric temperature into quartz, quartzite, and other stones, by James Parkinson. South of the Flinders Range fragments of stone of all sizes are found on the ground, the origin of which the author discussed. He maintained that they were formed by subaërial metamorphism of Eolian deposits. A discussion followed, in which the President, Mr. R. D. Oldham, Prof. T. Rupert Jones, Dr. H. Woodward, Mr. Marr, Dr. G. J. Hinde, and Mr. E. T. Newton took part.

Zoological Society, January 16.—Sir W. H. Flower, K.C.B., F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's menagerie during the month of December, 1893.—Mr. Sclater exhibited and made remarks on a drawing of the head of a monkey (*Cercopithecus erythrogaster*) in the Paris Museum, forwarded to him by M. Pousargues, of that institution.—An extract

was read from a letter received from Mr. C. B. Mitford, describing an invasion of locusts observed at Free Town, Sierra Leone. Mr. C. O. Waterhouse had referred the specimens of these insects sent home to *Pachytylus migratoroides*. A further extract from the same letter gave an account of the occurrence of the elephant in the district of Sierra Leone.—Mr. R. Lydekker gave an account of some of the principal objects observed during his recent visit to the La Plata Museum, calling special attention to the splendid series of remains of Dinosaurian reptiles, of Cetaceans, and of Ungulates of three different suborders. Mr. Lydekker also made remarks on some of the specimens of Edentates, and of the gigantic birds of the genus Brontornis.—Mr. Lydekker also exhibited a painting of the head of a wild goat (*Capra ægagrus*) of unusual size.—On behalf of Mr. J. Jenner Weir, a specimen of the Tsetse Fly (*Glossina morsitans*) from the Transvaal was exhibited.—Mr. Tegetmeier exhibited a curiously barred variety of the common pheasant.—A communication was read from Prof. W. N. Parker, containing remarks on some points in the structure of the young of the Australian Echidna.—A communication was read from Mr. Roland Trimen, F.R.S., giving an account of a collection of butterflies made in Manica, Tropical South-east Africa, by Mr. F. C. Selous in the year 1892. Of 166 species represented in the series, 44 were stated to be of general distribution, and of the remainder (amongst which were nine apparently new to science) 26 were peculiar to the South-Tropical area of Africa.—A communication received from Dr. A. B. Meyer contained remarks on a rare African monkey (*Cercopithecus wolfi*), accompanied by a coloured drawing.—Dr. A. Günther, F.R.S., gave an account of a collection of reptiles and fishes made by Dr. J. W. Gregory during his expedition to Mount Kenia. The collection contained examples of 37 species of reptiles, 9 of Batrachians, and 13 of fishes. Several species of reptiles were new to science, amongst which were two new lizards—*Bunocnemis modesta*, g. et sp. n., of the family Geckotidæ, with imbricate scales and large scattered conical tubercles on the hinder part of the hind limbs; and *Agama gregorii*, allied to *A. cyanogaster*, but with lateral, not tubular nostrils. Six new fishes were also characterised and named:—*Chromis niger*, *Chromis spilurus*, *Alestes affinis*, *Labeo gregorii*, *Barbus tanensis*, and *Barbus taitensis*.

Royal Meteorological Society, January 17.—Dr. C. Theodore Williams, President, in the chair.—The council in their report stated that the Society had made steady and uninterrupted progress during the year, there being an increase in the number of Fellows, and the balance of income over expenditure being greater than in 1892. They also reported that Dr. C. Theodore Williams, previous to vacating the office of President, had expressed a desire for the formation of a fund for carrying out experiments and observations in meteorology, and that he had generously presented to the Society the sum of £100 to form the nucleus of a research fund.—The President, Dr. C. Theodore Williams, in his valedictory address gave an account of the climate of Southern California, which he made most interesting by exhibiting a number of lantern slides. In the autumn of 1892 Dr. Williams visited this favoured region, chiefly with a view of investigating its present and future resources, and its suitability for invalids. After describing the entrance into California from Utah and Nevada, the general geography, and the mountain ranges, he pointed out that the mountain shelter is tolerably complete, and that the protected area consists of (1) valleys, chiefly running into the coast range from the sea, and rising to various elevations, such as the fertile San Fernando and San Gabriel valleys, or else (2) more or less extensive plains, as those of Santa Aña and San Jacinto. Southern California is subdivided into two portions, eastern and western, by the Sierra Nevada, and its spurs, the San Gabriel and San Bernadino mountains. The climate of the eastern portion, which is an arid region, is very dry, very hot in summer, and moderate in winter. The climate of the western portion has three important factors, viz. (1) its southern latitude, (2) the influence of the Pacific Ocean, and especially of the Kuro Suvo current, which exercises a similar warming and equalising influence on the Pacific coast of North America as the Gulf Stream does on the western coasts of the British Isles and Norway; and (3) the influence of mountain ranges, these affording protection from northerly and easterly blasts, and also condensing the moisture from the vapour-laden winds blowing from the Pacific. Dr. Williams then gave particulars as to the temperature and rainfall at Los Angeles, San Diego, Santa Barbara, and Riverside. From these it appears that the climate of Southern California is warm and temperate, and on the whole equable, with more moisture than that of Colorado, and that it is a climate which would allow of much outdoor life all the year round. The President next described the effect of the climate on vegetation, and showed what results had been obtained by diligent watering and gardening in this beautiful region. Wine and brandy are made in South California, but oranges and lemons are the leading crops, varied with guavas, pineapples, dates, almonds, figs, olives, apricots, plums and vegetables. On higher land, apples, pears and cherries bear well, and our English summer small fruit is also grown; while strawberries ripen all the year round, and are plentiful except in July and August. Dr. Williams concluded by saying that many an invalid has regained vigour and health, as well as secured a competence, in the sunny atmosphere of Southern California.—Mr. R. Inwards was elected President for the ensuing year.

Linnean Society, January 18.—Mr. W. Carruthers, F.R.S., Vice-President, in the chair.—Messrs. T. B. Cato, W. Elborne, and R. E. Leuch were admitted, and the following were elected:—Sir Hugh Law, Messrs. G. B. Rothera and Thomas Sim.—The chairman, before proceeding to the business of the evening, referred to the loss which the Society had sustained by the recent death of Mr. Richard Spruce, who had travelled and collected much in South America, and who was the recognised authority on *Hepaticæ*. It was much to be regretted that, having but lately presented to the Society a valuable paper on this subject, containing descriptions of a great number of new species, and illustrated with careful and beautiful drawings, he had not lived to see the published result of his labours. The chairman also feelingly referred to the death of Mr. Algernon Peckover, of Wisbech, who had been a Fellow since 1827, and who by his will had bequeathed to the Society a legacy of £100.—Mr. E. M. Holmes exhibited a flowering specimen of a new species of *Cascarilla* (*C. Thomsoni*), and the bark of the tree from New Granada; also two new foreign seaweeds, *Gelidium Beckeri* from South Africa, and *Leptocladia Binghamiæ* from California, and three new British marine algæ, viz. *Entophysalis granulosa* and *Symploca atlantica* from Swanage, collected by himself; and *Vaucheria coronata* from Arbroath, collected by Mr. J. Jack.—Mr. Thomas Christy exhibited and made observations upon some remarkably long tendrils of *Landolphia Kirkii*, which served as an illustration to a paper subsequently read by Mr. Henslow.—Mr. J. E. Harting exhibited and made some remarks upon the plant *débris* ejected in the form of "pellets" or "castings" by rooks, and stated that a number of these pellets which had been examined were composed of the cuticles of the succulent rook, of the couch grass *Triticum repens*, commonly called "scutch," "squitch," and "twitch" grass, a most troublesome weed to the farmer. Mr. Harting also exhibited a rare Australian duck, *Stictonetta nævosa* (Gould), which had been obtained at Gippsland Lakes, Victoria, and of which very few examples were to be found in collections.—A paper was then read by the Rev. G. Henslow, on the origin of the structural peculiarities of climbing stems by self-adaptation in response to external mechanical forces. The purport of this paper was to prove, by an appeal to facts and experiments, the existence of the power in living protoplasms of responding to external and purely mechanical forces by enveloping supportive tissues, by means of which the plant is enabled to resist the effects of gravity, tensions, pressures, &c. In the case of climbers, not only is this principle illustrated wherever a force is felt, but whenever a strain is relieved of a force atrophy, or arrest of mechanical tissues takes place, supplemented, however, by an increase in the number and size of vessels. The conclusion arrived at was that while, on the one hand, the peculiar structures of climbers are all the outcome of a response to the external mechanical forces acting directly upon the stems, such structures are precisely those which are most admirably suited to the requirements of the stems themselves. The variations of structure characteristic of species, genera, and orders of climbing plants have been thus acquired in a definite direction, viz. of direct adaptability, this being effected, according to Mr. Darwin's statement, "without the aid of natural selection." The paper was criticised by Dr. D. H. Scott, Prof. Reynolds Green, and Mr. G. Murray, who, while testifying to the number of interesting facts brought forward by Mr. Henslow to support his views, were yet unable to agree with him in several of his conclusions. The paper was illustrated by a great variety of specimens and drawings, and was listened to with considerable interest by a very full meeting.

PARIS.

Academy of Sciences, January 15.—M. Lœwy in the chair.—The death of M. P. J. van Beneden was announced, and a short account of his scientific career given by M. Emile Blanchard.—On the theory of the photography of simple and compound colours by the interference method, by M. G. Lippmann. The mathematical theory of the action of light on the photographic film is developed at length.—On a problem in mechanics, by M. A. Potier. The author gives a simple solution of the problem proposed by M. J. Bertrand concerning the law of the forces for a point describing a conic section.—Studies on the formation of carbonic acid and the absorption of oxygen by the detached leaves of plants. Experiments made at the ordinary temperature with the concurrence of biological activity, by MM. Berthelot and G. André. The results for wheat, *Corylus avellana* and *Sedum maximum*, are compared with the results, previously obtained and described, of strictly chemical character, and hence the results of the biological activity of the living matter of the leaves are deduced.—On a method for the study of gaseous exchanges between living things and the atmosphere which surrounds them, by M. Berthelot. A method is indicated whereby, by means of periodical analyses of an atmosphere, which is large compared to the respiratory needs of the living specimen, the changes caused by the organism can be examined while it is living in the normal manner.—On the chronostylographic method, and its applications to the study of the transmission of waves in tubes, by M. A. Chauveau. A description of the use of some improved instruments such as might be used for the study of the movements of all kinds occurring in the animal economy.—Observations on the *Æpyornis* of Madagascar, by MM. A. Milne-Edwards and Alfred Grandidier. A quantity of new material from Madagascar has been examined with the result that the remains have been classed in two main divisions, Æpyornis and Mullerornis, each with several described species.—Generalisation of some theorems in mechanics, by M. A. Kotelnikoff.—On the pendulum of varying length, by M. L. Lecornu. A mathematical study of the conditions during the oscillation of a pendulum of which the length varies in a definite manner.—Emission of sounds, by M. Henri Gilbault. It is shown that, in the ordinary case of vibrating bodies of three dimensions, the time occupied in communicating its energy to the air varies with the nature of the surface of each particular body.—Is there oxygen in the atmosphere of the sun? A note by M. Arthur Schuster. Attention is directed to a letter by the author published in NATURE (December 20, 1877) in connection with M. Duner's recent communication on this subject.—On the magnetisation of soft iron, by M. P. Joubin. The characteristic equation deduced from Rowland's experimental results is $x = 1 + 0{\cdot}33\ (1 - y) \pm 1{\cdot}3\ \sqrt{1 - y}$ where $x = \dfrac{I}{I_c}$ and $y = \dfrac{K - K}{K_c - K_0}$; I is the intensity of magnetisation, and K the susceptibility of the material.—The relation of storms at Parc de Saint-Maur to the position of the moon, by M. E. Renou. The author believes that he has shown that, in this district, storms are more frequent with a northern than with a southern declination of the moon.—On the combination of hydrogen and selenium in an unequally heated space, by M. H. Pélabon. A thermodynamical study of the reaction, showing that the experimental results agree with the predictions.—Ceric bichromate and the separation of cerium from lanthanum and didymium, by M. G. Bricout. A crystalline bichromate is deposited electrolytically from a solution of cerous carbonate in chromic acid, lanthanum and didymium give no deposit on the positive pole from chromic solution, hence a method for the separation of cerium as a pure soluble salt.—Researches on the desiccation of starchy matters, by MM. Bloch.—On the liquid from albuminous periostitis, by M. L. Hugounenq. Analyses show that the periostitial exudation resembles that of "hydarthrose" most nearly.—Influence of atmospheric agencies, particularly light and cold, on the pyocyanogenous bacillus, by MM. d'Arsonval and Charrin.—On the amibocytes, the oogenesis and the ovi-deposition of *Micronereis variegata*, by M. Emile G. Racovitza.—On the synchronism of the coal basins of Commentry and St. Etienne and its consequences, by M. A. Julien.—On the epidermis of the egg-bearing peduncles and seeds of *Bennettites Morierei*, by M. O. Lignier.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Fauna of the Deep Sea: Dr. S. J. Hickson (Kegan Paul).—The Technique of Post-Mortem Examination: Dr. L. Hektoen (Chicago, Keener and Co.).—Climates of the United States, in Colors: Dr. C. Denison (Chicago, Keener and Co.).—Physiology Practicums: Dr. B. G. Wilder (the Author, Ithaca).—Biologischer Atlas der Botanik, Serie "Iris," Erläuternder Text: Dr. A. Dodel.—Ditto, Tafel 1 to 7 (Zürich, Schmidt).—The Royal Natural History, Vol. 1, Part 3 (Warne).—Ninth Annual Report of the Bureau of Ethnology (Washington).—Annals of the Astronomical Observatory of Harvard College, Vol. xxix., Miscellaneous Researches made during the Years 1883-93 (Camb., Mass.).—Ditto, Vol. xxv., Comparison of Positions of Stars &c., &c.: W. A. Rogers (Waterville, Me.).—Ditto, Vol. xl. Part 2, Observations made at the Blue Hill Meteorological Observatory, Mass., U.S.A., in the year 1892: A. L. Rotch (Camb., Mass.).—Ditto, Vol. xxxi. Part 2, Investigations of the New England Meteorological Society for the year 1891 (Camb., Mass.).—Heat, an Elementary Text-Book, Theoretical and Practical: R. T. Glazebrook (Cambridge University Press).—The Yoruba-Speaking Peoples of the Slave Coast of West Africa: A. B. Ellis (Chapman and Hall).—Congrès International de Zoologie. Deux. Session à Moscou, Deux. Partie (Moscou).

PAMPHLETS.—Sugar Maples, and Maples in Winter: W. Trelease (St. Louis, Mo.).—Royal Gardens, Kew, Official Guide to the Museums of Economic Botany, No. 3, Timbers, 2nd edition (Eyre and Spottiswoode).—Notes of Research on the New York Obelisk: A. A. Julien.—Some Ancient Relics in Japan: R. Hitchcock (Washington).—The Ancient Burial Mounds of Japan: R. Hitchcock (Washington).—Shinto, or the Mythology of the Japanese: R. Hitchcock (Washington).—The Ainos of Zezo, Japan: R. Hitchcock (Washington).—The Ancient Pit Dwellers of Zezo, Japan: R. Hitchcock, Washington).—Bibliography of the Salishan Languages: J. C. Pilling (Washington).—The New Nati nality of the Nile: Drs. Sarruf and Nimr (Cairo).—Report of the Superintendent of the U.S. Naval Observatory for the Year ending June 30, 1893 (Washington).—The Cincinnati Southern Railway: J. J. Hollander (Baltimore).

SERIALS.—Zeitschrift für Wissenschaftliche Zoologie, lvii. Band, 2 Heft (Williams and Norgate).—The Psychological Review, No. 1 (Macmillan).—The Botanical Gazette, December (Bloomington).—Gazzetta Chimica Italiana, Vol. 2, fasc. 12 (Palermo).—Palestine Exploration Fund, Quarterly Statement, January (Watt).—The Quarterly Journal of Microscopical Science, January (Churchill).—Quarterly Review, January (Murray).—Zeitschrift für Physikalische Chemie, xiii. Band, 1 Heft (Leipzig).—Journal of the Franklin Institute, January (Philadelphia).—Journal de Physique, January (Paris).—Proceedings of the Academy of Natural Sciences of Philadelphia, 1893, Part 2 (Philadelphia).—Bulletin of the U.S. National Museum, No. 46—The Manapoda of North America: C. H. Bollman (Washington).—Rendiconto dell' Accademia delle Scienze Fisiche e Matematiche, Serie 2, Vol. 7, fasc. 8 and 12 (Napoli).—Astronomy and Astro-Physics, January (Wesley).—Nuovo Giornale Botanico Italiano. Nuova Serie (Vol. 1, No. 1 (Firenze).

CONTENTS.